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Marine Casualty
Investigations

Enquêtes sur les
accidents maritimes

**Investigation
Report
to the Minister
pursuant
to sections
477 or 480
of the
Canada
Shipping Act
(1985)**

**Rapport
d'investigation
au Ministre
conformément
aux articles 477
ou 480 de la Loi
sur la marine
marchande
du Canada
(1985)**

Canada

91-05128/

Ce rapport est aussi disponible en français

REPORT OF INVESTIGATION INTO THE
CIRCUMSTANCES ATTENDING THE SINKING OF THE
VANUATUAN REGISTERED VESSEL
"CAPITAINE TORRES", IN THE GULF OF
ST. LAWRENCE, CANADA, ON
DECEMBER 8, 1989, WITH THE LOSS
OF HER FULL COMPLEMENT OF 23 PERSONS.

REPORT No. 550

These sections of the Investigation Report prepared pursuant to Section 477, or of the Preliminary Inquiry Report prepared pursuant to Section 480, of the Canada Shipping Act, (1985) and released for accident prevention purposes only and are confined to cause-related circumstances.

This report and its contents may be deficient and misleading if used in any other process and are not to be used or admitted in evidence in any legal proceedings, either civil or criminal, arising out of the casualty described in the report. The statements, opinions and findings in the report are those of the Marine Casualty Investigations Division only and do not constitute admissions made by or on behalf of Her Majesty the Queen in right of Canada.

Ces sections du rapport d'investigation ou du rapport préliminaire sont rédigées en vertu des articles 477 et 480 respectifs de la Loi sur la marine marchande du Canada (1985) et ne sont publiées qu'à des fins de prévention des accidents seulement et ne portent que sur les circonstances entourant le cas à l'étude.

Ce rapport et son contenu peuvent être insuffisants et trompeurs s'ils sont utilisés à d'autres fins et ne peuvent être utilisés ou acceptés comme preuve dans quelque procédure que ce soit, au civile ou au criminel, même si ces procédures découlent de l'accident décrit dans ledit rapport. Les déclarations, les opinions et les constatations de ce rapport appartiennent uniquement à la section des Enquêtes sur les accidents maritimes et ne constituent pas une acceptation de la part ou au nom de Sa Majesté du chef du Canada.

TRANSPORTATION SAFETY BOARD OF CANADA

ADDENDUM

The Republic of Vanuatu has made the following comments:

In Relation to Analysis Paragraph 21

- (i) Section 35 of the Vanuatu Maritime Regulations 1981 (as amended) under Order No. 104 of 1981 and order No. 42 of 1982 made under Section 46 of the Vanuatu Maritime Law 1981 (as amended) require that the Master must enter in the official log book the time of muster of crew at their boat and fire stations, followed by drills, respectively at least once a week, either in port or at sea, or the reason why not held.
- (ii) Vanuatu did, therefore, require the musters and drills required by SOLAS.
- (iii) Vanuatu's position regarding SOLAS amendments 1981 and 1982 is identical to all other Parties to SOLAS in that none of the Parties acceded, since the amendments automatically apply to all Parties under the SOLAS procedures.
- (iv) Vanuatu revised its regulations early in 1990 to bring the certification into line with the STCW Convention and this would have been ratified at the time of the casualty but for parliamentary procedures.

TSB - April 23, 1991

Effective March 29, 1990, the mandate to conduct investigations into Marine occurrences was transferred to the Transportation Safety Board of Canada (TSB) - Investigations Marine. In accordance with the Act establishing this new organization, outstanding investigations conducted under the Canada Shipping Act prior to this date are being completed and distributed by TSB - Investigations Marine.

Depuis le 29 mars 1990, le Bureau canadien de la sécurité des transports (BST) - Enquêtes - Maritimes, a reçu le mandat de mener les enquêtes sur les accidents maritimes. Conformément à la loi créant ce nouveau Bureau, les enquêtes en cours prévues par la Loi sur la marine marchande seront terminés et les rapports distribués par le BST - Enquêtes Maritimes.

Particulars of Vessel

Name (since October 1989)	"CAPITAINE TORRES"
Official Number	5016
Call Sign	YJXZ3
Port of Registry (since October 1989)	Port Vila, Vanuatu, two year Bareboat Charter Registry; transferred from Matu Utu, Wallis and Futuna Islands
Former Registry (since August 8, 1989)	Matu Utu, Wallis and Futuna Islands
Former Name (since building 1979)	"SUNNY ISABELLA"
Previous Registries (since building 1979)	Monrovia, Liberia and Limasol, Cyprus
Gross Tonnage	6,393.44 } Classification Society, } Provisional Tonnage
Net Tonnage	4,646.90 } Certificate
Length B. P.	117.0
Breadth Mld.	19.8 m
Depth Mld.	10.5 m
Departure Draughts (FW)	Forward 7.98 m Aft 7.87 m
Type	Multi-purpose/semi-containership of steel construction
Built	1978 Hyundai Heavy Industries Ulsan, South Korea
Classification Society	Germanischer Lloyd

Propulsion	Four stroke, single acting, direct reversible, fresh water cooled, turbo charged, 12 cylinder MWM diesel of 4,413 kW, driving one fixed-pitch propeller
Cargo	One, disassembled steel mill in numerous cases, crates, pallets, containers, etc. Total weight some 7,684 tonnes, stowed below decks and on deck
Crew	23, Multinational
Owners	Sofrana Unilines Ltd. Sydney, Australia
Charterers	Rhode and Hesenfeld Texas, U.S.A.
Former Owners	Latian Marine Co. Ltd. Cyprus
Former Managers	Columbia Ship Management Cyprus
<u>Navigational Equipment</u>	
Radar (1)	Fitted
Radar (2)	Fitted
Echo (depth) Sounder	Fitted
Sat Nav System	Fitted
Gyro Compass	Fitted
Magnetic Compass	Fitted
Radio Direction Finder	Fitted
<u>Lifesaving Appliances</u>	
Open Lifeboats	Two, one on each side of the accommodation, each capable of seating 36 persons.
Enclosed Lifeboats	None (not required by Regulation).

Enclosed Inflatable Liferrafts	Two, one on each side of the accommodation, each designated to hold 16 persons. Last serviced in May 1989.
Lifejackets	36
Life Buoys (with lights)	8
Line Throwing Apparatus	1
Survival Suits	None (not required by Regulation).

Distress Rockets and Signals

Ship	12 red parachute flares
Each Lifeboat	4 red parachute flares 6 red hand-held flares 3 orange smoke signals (Date of manufacture, August 1988)
Each Liferaft	2 red parachute rocket flares 6 red hand-held flares (dates of manufacture January and February 1987)

Description of Vessel

The "CAPITAINE TORRES", ex "SUNNY ISABELLA", was an all-steel, multi-purpose/semi-container vessel with engines and accommodation situated aft and with three cargo holds forward, each fitted with steel hatch covers. The holds consisted of a lower hold and a 'tween deck, capable of being loaded with either general cargo or standard size containers. Additional general cargo or a further three tiers of containers could be loaded on the weather deck hatch covers and deck.

The main engine controls were of a type designed to operate the engine from the navigation bridge, however, they were reportedly not used as such but as a means of transmitting orders to the engine-room staff.

When the crew abandoned the vessel, attempts were made to utilize the two inflatable liferafts and a lifeboat.

Certificates and Registry

The vessel had been purchased by her latest owners in October 1989, some 2 months prior to sinking, and handed over to them at Emden, West Germany, where her registry was changed to Matu Utu in

the French overseas territory of Wallis and Futuna in the Pacific islands and then to a 2 year bareboat charter registry at Port Vila, Vanuatu, Pacific Islands.

The Vanuatuan registration was subject to her final certificates being issued by her Classification Society and verified by the Vanuatuan Department of Maritime Affairs; therefore, at the request of the new owners, and while at Emden during October 1989, the vessel underwent successful surveys by her Classification Society, which had classed her continuously since building in 1979 and had continued her class in 1988 valid until 1992. As a result of the surveys, the Society issued a Cargo Ship Safety Equipment Certificate, a Safety Construction Certificate, an International Loadline Certificate and a Safety Radiotelegraphy Certificate under the vessel's new name of "CAPITAINE TORRES". All of these certificates, plus her other certificates, including her certificate of class which had been issued and remained under her former name of "SUNNY ISABELLA", were valid at the time of sinking.

NOTE: (1) All times in this report are expressed in Atlantic Standard Time (UTC minus 4 hours) unless otherwise stated.

(2) A Glossary of terms and abbreviations may be found following the Findings in this report.

Preamble

Due to the absence of material witnesses to the casualty, this report is compiled from evidence provided by associated persons, together with written information provided by various Companies and Authorities and also from recorded radiotelephone communications made by the vessel during the 8 hours prior to sinking.

Background

Having loaded a full cargo in the United States of America and having navigated the Great Lakes and St. Lawrence Seaway, the "CAPITAINE TORRES" departed Les Escoumins, Quebec, Canada, on December 6, 1989, bound for Taiwan via Panama. While in the Gulf of St. Lawrence and approaching the Cabot Strait, some 27.5 hours later, the vessel broke down in deteriorating weather conditions. Approximately 8 hours later during the early hours of December 8, the crew attempted to abandon while the vessel was heavily listed and sinking in storm conditions.

The vessel sank at approximately 0327, December 8, in position 47°23.4' N, 060°12.0' W, and despite extensive search and rescue efforts by the Canadian Coast Guard, the Canadian Department of National Defence and various commercial vessels, none of the ship's

complement of 23 persons was rescued and all are presumed drowned. The vessel was valued at some \$5,500,000 and is considered to be a total loss, having sunk in 200 fathoms (366 m) of water. Pollution consisted of the vessel's fuel and lubricating oils.

During the same storm and in a position some 95 miles from the "CAPITAINE TORRES", another commercial vessel sank with the loss of her full complement of 16 persons. Numerous other vessels in the area suffered weather related structural damage.

Particulars of Deceased

Name	Claude Vicario
Position on Board Ship	Captain
Age	40
Nationality	French

Name	Michel Pellerin
Position on Board Ship	Chief Officer
Age	35
Nationality	French

Name	Rae Paul Simpson
Position on Board Ship	2nd Officer
Age	28
Nationality	Fijian

Name	William Motufaga
Position on Board Ship	3rd Officer
Age	35
Nationality	Fijian

Name	Omolon Lorenzo
Position on Board Ship	Radio Officer
Age	53
Nationality	Philippino

Name	Pieter Groenendijk
Position on Board Ship	Chief Engineer
Age	34
Nationality	Dutch/New Zealand

Name	Lafita Vaaia
Position on Board Ship	2nd Engineer
Age	39
Nationality	Tuvaluan

Name	Tima Semilota
Position on Board Ship	3rd Engineer
Age	29
Nationality	Fijian
Name	Vincent Kanimea
Position on Board Ship	4th Engineer
Age	38
Nationality	Fijian
Name	Okostino Apao
Position on Board Ship	Fitter
Age	39
Nationality	Fijian
Name	Hanifiro Hiagi
Position on Board Ship	Electrician
Age	43
Nationality	Fijian
Name	Polikalepo Seupakisi
Position on Board Ship	Bosun
Age	38
Nationality	Futuna
Name	Devenou Betuel
Position on Board Ship	Able Seaman
Age	51
Nationality	Vanuatuan
Name	Tolo Inoke Kaituu
Position on Board Ship	Able Seaman
Age	30
Nationality	Fijian
Name	Robin Vairaa
Position on Board Ship	Able Seaman
Age	33
Nationality	French
Name	Kamaliele Vaisala
Position on Board Ship	Able Seaman
Age	29
Nationality	French
Name	Iana Munue
Position on Board Ship	Able Seaman
Age	23
Nationality	Fijian

Name	Dominique Jean Louis
Position on Board Ship	Delaplane
Age	Greaser
Nationality	25
	French

Name	Ipolito Misimoa
Position on Board Ship	Greaser
Age	25
Nationality	French

Name	Tom Simon
Position on Board Ship	Greaser
Age	27
Nationality	Vanuatuan

Name	John Kalosarur
Position on Board Ship	Cook
Age	24
Nationality	Vanuatuan

Name	Ateleha Siale
Position on Board Ship	Chief Steward
Age	49
Nationality	French

Name	Georges Tom
Position on Board Ship	Steward
Age	27
Nationality	Vanuatuan

Narrative

The crew which was employed by the new owners joined the vessel at Emden, West Germany, in October 1989 and from that time until departure for Canada, on October 28, spent their time in familiarizing themselves with the vessel while also undertaking maintenance work and assisting with the Classification Society surveys.

The vessel departed Emden, empty of cargo and in ballast, having been time chartered to transport a steel mill from Illinois, U. S. A., to Taiwan while enroute to Auckland, New Zealand, where she was reportedly to be employed by the new owners in a cargo liner service.

Since departure from Emden and during the 14 day passage across the North Atlantic, a number of engine problems occurred which required the vessel to stop at sea for repairs on at least one occasion. Further engine problems occurred during the passage

through the Great Lakes and Seaway to Burns Harbour, Illinois, U.S.A., where the vessel arrived on November 18, 1989. After making engine repairs at Burns Harbour and loading a full cargo, the vessel departed for Taiwan at 2200, United States Central Time (USCT), November 26, 1989.

A further series of machinery problems occurred during the outward passage through the Great Lakes and Seaway before disembarking the last of her pilots at Les Escoumins, Quebec, on December 6, 1989. A more detailed description of the machinery problems experienced by the vessel is contained in Analysis 6 of this report.

The "CAPITAINE TORRES" had departed Burns Harbour, having completed loading a full cargo at 1700 USCT that day and having spent the previous 9 days loading the cargo at Burns Harbour. The cargo consisted of part of a disassembled steel mill which was to be transported to Kaohsiung, Taiwan. It consisted of numerous pieces of steel and other parts of the mill packaged in various crates, boxes, containers and on pallets and as individual, unpackaged pieces.

The loading and securing of the underdeck cargo had been undertaken by a local stevedore company under the guidance of the ship's personnel and a cargo consultant for a survey company which acted on behalf of the charterers. The final cargo loaded was the deck cargo, consisting of three wooden portable control rooms loaded on number two hatch and nine containers loaded at the after end of number three hatch, together with numerous unprotected steel mill parts loaded on the weather deck either side of numbers two and three hatchways. As was usual, the securing of cargo below decks had been completed by the stevedores during the loading process. The securing consisted of wire and chain lashings together with wooden shores and supports as required. The securing of the deck cargo was not completed by the stevedores but, by agreement, was left to the ship's crew who reportedly commenced securing it in a similar manner as soon as the deck cargo had been loaded on board.

During the 10 day outward pilotage through the Great Lakes and the St. Lawrence Seaway to Les Escoumins, Quebec, it was found on a number of occasions that the vessel had difficulty in responding to engine orders, with a consequence that extreme care was required by pilots when manoeuvring into and out of locks, etc. Also during the pilotage and shortly after leaving Burns Harbour, the vessel had been stopped for 6 hours to reportedly effect air-compressor repairs and, being unable to anchor due to the depth of water, had drifted in Lake Michigan.

The vessel had also grounded during the outward pilotage while at anchor in Lake St. Francis during poor visibility and while awaiting permission to proceed into a seaway channel; however, the grounding was due to the anchor dragging during the time taken to heave it aweigh and not due to main engine problems. The vessel was refloated by use of her main engine and, following an inspection of the double-bottom tanks and bilges by the ship's personnel, it was determined there was no apparent damage; nor was damage apparent to the propeller or rudder. Therefore, the vessel was allowed to proceed by the Seaway Authority who made external inspections of the hull at each subsequent lock.

There were no scheduled stops enroute such as to take on additional cargo, stores or fresh water, etc., other than a stop at Montreal, where the vessel anchored for 1.5 hours in order to embark two additional crew members.

At 1710, on Wednesday, December 6, 1989, after disembarking the last of her pilots, comprising the two pilots who had had the conduct of the vessel from the Port of Quebec to Les Escoumins, Quebec, the vessel proceeded on the 500 mile voyage through the Gulf of St. Lawrence and Cabot Strait with the intention of reaching the North Atlantic Ocean and thence by ocean passage to Panama and her destination.

The weather conditions were fair at departure from Les Escoumins but forecasts issued by Environment Canada indicated that westerly to north-westerly gales could be expected during the next 24 hours. In addition, a rapidly deepening low pressure system was observed to be moving eastwards towards Quebec and the Gulf of St. Lawrence which caused Environment Canada to issue a storm warning at 1600 that day, December 6, which was broadcast at 1610 and which forecast north-westerly gales of 50 to 55 knots in all of the northern marine areas for the following day, Thursday, December 7. The storm warning was followed by scheduled forecasts broadcast at 6 hour intervals from 1700 indicating similar severe weather conditions.

The vessel maintained radiotelephone contact with the St. Lawrence Waterway Vessel Traffic Service Centre as was required for vessel traffic monitoring and regulation and at 0013, December 7, had reached the eastward, i.e., outer limit, of their zone situated at longitude 66°00' West in the mouth of the St. Lawrence River. She then reported her estimated time of arrival (ETA) as 2200, December 7, 1989, at the next calling-in position, which is required by Eastern Canada Vessel Traffic Services Zone Regulations (ECAREG), and is some 280 miles further eastward through the Gulf of St. Lawrence and in the Cabot Strait; however, that position was never reached.

Calculations show that the vessel had averaged a speed of some 14 to 15 knots until arrival at 66°00' West, which was reportedly her normal speed at full ahead in good weather conditions.

The next communication was a radiotelephone call made from the vessel at 1936, December 7, reporting to ECAREG via Sydney Coast Guard Radio Station (VCO) and subsequently to any other ship in the area indicating that she had lost the three wooden control rooms overboard from number two hatch and was stopping her main engine for reasons which were not identified at the time. Later it was reported that repairs to the air compressors were being carried out and that it was expected that the vessel would be stopped for approximately 3 hours. The prevalent sea conditions had caused the vessel to roll and pitch heavily, with a consequence that other deck cargo had also shifted and the vessel was listing some 2° to port while shipping seawater on deck. The position was given as 47°33' N, 60°44' W, which is some 34 miles north of Cape North, Nova Scotia, and some 24 miles northwest of the position in which the vessel sank.

The message was immediately relayed by VCO to the Rescue Co-ordination Centre (RCC) at Halifax, Nova Scotia, who in turn tasked the Canadian Coast Guard Ship (CCGS) "SIR WILFRED GRENFELL", which was secure at her berth at Port aux Basques, Newfoundland, some 65 miles to the eastward and was the nearest CCGS to the scene.

The weather conditions at the time of the main engine stoppage were extremely adverse, and as reported by the "CAPITAINE TORRES" at 2103, were: Winds northwest force 10 Beaufort scale, i.e. 48 to 55 knots, rough seas of 5 metres in height, sky overcast, snow flurries and the air temperature minus 3° Centigrade.

By 1955, a continuous, open radiotelephone communications channel (16 VHF) had been established between VCO and the "CAPITAINE TORRES" and at that time VCO asked if it was the vessel's intention to declare a Mayday. The "CAPITAINE TORRES" replied that it was not the intent at that time but would like to have any other vessel which might be in the area standing by; VCO replied that the CCGS "SIR WILFRED GRENFELL" had been tasked and was departing Port aux Basques. The "SIR WILFRED GRENFELL" departed Port aux Basques at 2042 and in the meantime the Canadian Forces Base (CFB) at Summerside, Prince Edward Island, had also been alerted and a fixed-wing aircraft became airborne at 2200, enroute to the "CAPITAINE TORRES". The aircraft's purpose was to provide assistance by acting as the 'on scene' rescue commander and provide directions to surface vessels through radiotelephone communications and through illumination by dropping flares, also to provide assistance to the "CAPITAINE TORRES" by dropping pumps if required. In addition, a Search and Rescue helicopter had been tasked from CFB Summerside which attempted rescue operations but due to the

weather conditions was kept on standby to become airborne only if life threatening conditions arose and the weather permitted take-off; however, the conditions remained too severe to allow its use.

Of several other commercial vessels in the area, two which were within 35 miles of the "CAPITAINE TORRES" were also tasked to assist by RCC, but due to the extreme weather conditions were virtually hove-to and were released from assisting in order to keep their own damage to a minimum.

The fixed-wing aircraft made radiotelephone contact with the "CAPITAINE TORRES" at 2240 advising it would arrive over the ship's position at 2247. At that time, the CCGS "SIR WILFRED GRENFELL" was some 50 miles to the eastward and proceeding to the scene while heading westward into the storm at a speed of some 7.0 knots.

Meanwhile, another commercial vessel, the "JOHANNA B", had reported that she was in danger of sinking and had declared a Mayday while in position 48°27' N, 62°20' W, some 95 miles to the northwest of the "CAPITAINE TORRES".

At 2303 the fixed-wing aircraft had descended to 500 feet and, despite very poor visibility at that height due to snow and sea spray/spume, sighted the lights on the "CAPITAINE TORRES"; the personnel on the vessel also sighted the aircraft's lights. Further information was exchanged between the aircraft and the vessel to the effect that the list to port had increased to 15°, that a container from number three hatch had also been lost overboard and the remaining eight containers had shifted to port, but the vessel's condition appeared to be stable with no immediate danger of sinking. At the time, the vessel had also pumped all available ballast to the starboard tanks in order to help counteract the list. Additional pumps from the aircraft were not required as the vessel was periodically using her own bilge pumps which appeared to pump satisfactorily. However, the extent of damage to the decks and hatches, with a consequent downflooding of the holds, could not be properly ascertained due to the seas washing on board, making physical inspection by the crew too hazardous.

The fixed-wing aircraft was released by RCC from attending the "CAPITAINE TORRES" some 7 minutes later at 2310, in order to proceed to the "JOHANNA B" who had advised that she was taking water into her holds and was sinking; it was anticipated that the aircraft could drop the pumps in order to assist the "JOHANNA B". However, the vessel sank with the loss of her full complement of 16 persons before assistance could be rendered.

Before departing the area of the "CAPITAINE TORRES" the aircraft advised that the "SIR WILFRED GRENFELL" was some 50 miles distant. In the meantime, another fixed-wing aircraft had also been tasked and was proceeding to the scene.

At 0102, December 8, the "CAPITAINE TORRES" advised that two more containers had been lost from number three hatch and the list had increased to 20° to port, that it was doubtful if the main engine could be started and when again asked by VCO if the intent was to declare a Mayday, replied that it was; however, there was no intention to abandon at that time. At 0147, the "CAPITAINE TORRES" advised that the main engine was running and the vessel was proceeding in a southerly to southeasterly direction, at a speed of approximately 5 knots, with the wind and sea astern, still listing 20° to port and shipping a lot of water on deck. A further series of communications beginning at 0205 indicated the port list had increased and at 0218 that the engine had again broken down after running for some 30 minutes while the list had increased to 25° to port and the vessel was rolling through 30°, from 10° to 40° to port. However, at that time it was still believed that safety of personnel would be better served by remaining on board than by abandoning.

The "SIR WILFRED GRENFELL" made radiotelephone contact with the "CAPITAINE TORRES" and at 0304 advised she was about 5.5 miles from the scene, estimating the time of arrival to be less than one hour. At 0320 an exchange between the two vessels indicated the "SIR WILFRED GRENFELL" was 3.0 miles off, steering 235° true, and estimating arrival in 30 minutes. At about 0326 the list on the "CAPITAINE TORRES" had increased to some 40° to port and the intention was now to abandon using the ship's two inflatable liferafts but not the lifeboats. The "CAPITAINE TORRES" then advised that one of the two liferafts had broken free and had been lost; therefore, the intention was now to abandon via one liferaft and possibly one lifeboat.

At 0326, the last message transmitted from the "CAPITAINE TORRES" was to the "SIR WILFRED GRENFELL" stating in effect that the crew were abandoning ship with the one liferaft and a lifeboat and that the list was about 40° to port. At that time, the "SIR WILFRED GRENFELL" was 2.0 miles away with the radar target of the "CAPITAINE TORRES" clearly visible on the radar PPI (screen) but beginning to merge with the radar sea-clutter as the distance between the two vessels decreased. Shortly after, at a time estimated to be at 0327, the radar target disappeared from the screen in a position estimated to be 47°23.4' N, 060°12.0' W. It was thought at first that the target had become obscured in the radar clutter but the continued adjustment of the radar controls failed to regain it, therefore, it is considered the "CAPITAINE TORRES" sank at 0327, or shortly after.

The weather conditions at this time were reported by the "SIR WILFRED GRENFELL" to be: winds west-north-west 55 to 60 knots gusting to 70 knots, the seas rough and of some 9.1 to 10.7 m (30 to 35 ft) in height superimposed on a swell of some 4.8 to 5.4 m (16 to 18 ft). The visibility in the darkness had been reduced due to snow flurries and sea spray, being further reduced by sea spume lifted by the wind from the sea surface and also blown from the tops of waves. The air temperature recorded in the calm conditions of a protective screen was minus 3° centigrade; however, due to the wind chill factor, the equivalent temperature in exposed areas was considerably less, estimated to be in the region of minus 22°C.

During the passage from Port aux Basques, the weather conditions had caused ice accretion of some 7 to 10 cm to the rigging and superstructure on the "SIR WILFRED GRENFELL" and visibility had been made particularly difficult due to the heated wheel-house windows becoming obscured with freezing sea spray. The vessel was heading into the wind and spray, which also made the visibility ahead and from outside of the wheel-house extremely difficult.

The "SIR WILFRED GRENFELL" continued towards the last radar observed position of the "CAPITAINE TORRES" and at 0344 advised VCO that, although the position had been reached, there was no sign of the ship or survivors; she had switched her searchlights on and some 4 minutes later at 0348 saw a light ahead which, as the vessel approached, was seen to be the light on an inflated liferaft. Despite frequently sighting and then losing sight of the raft in the sea and visibility conditions, the "SIR WILFRED GRENFELL" managed to reach a position within approximately 35 m and observed one or two persons apparently kneeling at an open entrance to the raft's protective canopy; this person or persons indicated sighting the ship by waving.

Both of the rafts' protective canopy entrances were seen to be open with a consequent minimum weather/spray protection for the occupants; therefore, rather than attempt to stand-by and await more favourable weather conditions, it was decided to attempt rescue immediately. Two attempts were made to go alongside the raft after sighting it; however, at each attempt, the danger of over running the raft was too great and, while manoeuvring for the third attempt, it was lost to view and not seen again until some 4 hours later at 0745.

In the meantime it had become apparent that the raft was not radar detectable; therefore, the "SIR WILFRED GRENFELL" stayed on station in the position she had reached while keeping a look-out for lights, distress flares or rockets which might have been exhibited by the occupants; however, none were seen; neither was there any radiotelephone communication. While keeping station, the "SIR WILFRED GRENFELL" sighted some 12 lifejackets and four lighted

lifebuoys, all without occupant, together with a lifeboat radio, a considerable amount of wooden debris and what appeared to be the remains of a lifeboat.

During the 4 hours elapsed from the time of first sighting the raft at 0348 until 0745, daylight had occurred, the other fixed-wing aircraft had arrived on scene and visibility had increased to some 0.25 to 0.5 mile.

When the "SIR WILFRED GRENFELL" again sighted the raft at 0745, she manoeuvred alongside and at 0809 had recovered it from the sea by the use of grapnels and overside scrambling nets; however, it was unoccupied. While manoeuvring alongside, the raft was seen to have its canopy completely collapsed, the two canopy entrances secured in the open position and the upper of its two perimeter buoyancy chambers deflated.

At 0810, an aircraft involved in the search sighted the other liferaft, directed the "SIR WILFRED GRENFELL" towards it and at 0930 it too was recovered from the sea. This raft was also unoccupied, the canopy was also completely collapsed and its two entrances secured in the open position; however in this case, the perimeter buoyancy chambers were both inflated.

In the case of both rafts, it became apparent that the external sea anchors (drogues) on each had deployed in accordance with their designed stowage, but both were missing; one had detached from the raft at the position where its line had been secured to the raft, the other line appeared to have broken with part still secured to the raft.

During the remainder of that day, the "SIR WILFRED GRENFELL", together with numerous other surface vessels and aircraft, continued the search in severe weather conditions which considerably reduced their effectiveness. Several pieces of wooden debris and an unoccupied lifejacket were sighted but no persons or remains. At 1542, the "SIR WILFRED GRENFELL" proceeded to the lee of the nearest land in order to remove ice which had accreted to the superstructure due to snow and sea spray. The crew spent the remainder of the night removing the ice and, in the meantime, it was decided to proceed to Sydney, Nova Scotia, in order to land and hospitalize the ship's boatswain who had been injured while retrieving the rafts from the sea.

During Saturday, December 9, the search was maintained in continuing severe weather conditions, but without positive results, utilizing two Coast Guard surface vessels and four aircraft together with the assistance of several commercial vessels which passed through the area. By Sunday, December 10, the drift patterns of possible survivors from both the "CAPITAINE TORRES" and

the "JOHANNA B" were calculated to have merged on a track which would carry them through the Cabot Strait. Consequently, the search for both ships' personnel was combined, utilizing four surface vessels and four aircraft together with commercial vessels. At 0739, a swamped, open lifeboat with no occupant was sighted and identified by the "SIR WILFRED GRENFELL" as belonging to the "JOHANNA B". There were no further sightings of lifesaving appliances or debris associated with the "CAPITAINE TORRES" and at 1200, December 10, the search was placed on reduced status, some 56 hours having elapsed since the search was initiated and the "CAPITAINE TORRES" had sunk.

Two Canadian Coast Guard vessels continued the search until sunset, December 11, 1989, but without success, when it was referred to the Royal Canadian Mounted Police as a case of persons missing, believed drowned.

A lifejacket, identified as being part of the "CAPITAINE TORRES" personal lifesaving appliances, was found floating in the Gulf of St. Lawrence on May 30, 1990, some 54 months later. The lifejacket, together with the two liferafts, are the total articles recovered at the time of production of this report.

Analysis

1. Gulf of St. Lawrence. Meteorological Information

The East Coast of Canada (Maritimes), including the Gulf of St. Lawrence, has the reputation of experiencing some of the worst winter weather conditions in the world, which is described in the Canadian Hydrographic Service publication, Sailing Directions, Gulf and St. Lawrence River, in part, as follows:

Gulf of St. Lawrence - Winds - The Canadian Atlantic Provinces and the Gulf of St. Lawrence together constitute a region through which many cyclonic disturbances pass in the course of the year, ... Many of these are either in a process of intensification or have already reached maturity; these will produce gale to storm force winds which may persist for many hours. In some cases, the storm will decelerate or even stall in the vicinity, and at such times gale force winds have been known to persist for several days with little change in either strength or direction.....

The gale to storm force winds associated with the major disturbances may be accompanied by squalls of a more severe nature. It appears to be

a reasonable safe rule to assume that peak wind speeds in squalls may be up to half as great again as the average wind speed.

Storm force winds (Beaufort force 10; i.e., 48 knots or more) will average about 2 to 5 per cent of the time from late November until early April. Winds of close to 80 knots have been recorded on the Iles de la Madeleine in mid-winter....

Strong winds from a north to NW direction in the colder months are frequently responsible for freezing spray conditions.

However a well found ship, prudently handled, can survive these storms and, over the years, hundreds of vessels have done so.

2. Weather and forecasts

Weather forecasts issued by the Atmospheric Environment Service Department of Environment Canada during the 2 days prior to the vessel's arrival at Escoumins on Wednesday, December 6, indicated that gales and freezing spray could be expected for all of the 500 mile passage through the Gulf of St. Lawrence and Cabot Strait. (See the Annex to this report for the marine weather forecast areas.)

The Wednesday, December 6 forecast issued at 1130 had read as follows:

Northumberland Strait

Gulf Magdalen

Anticosti

Gale warning continued for Thursday.

Freezing spray warning continued.

Winds southwest 20 to 30 knots backing to southerly

25 to 30 overnight then diminishing to variable 15

Thursday morning. Visibility fair to poor in

precipitation. Freezing spray ending overnight.

Freezing spray beginning near noon Thursday.

Temperatures near minus 10 rising to near minus 4

overnight then lowering to near minus 10 near noon

Thursday. Outlook for Friday ... strong to gale

force northwesterlies diminishing to moderate north-
erlies.

Cabot Strait

Gale and freezing spray warnings continued.

Winds westerly 25 to 35 knots backing to southwest winds 20 to 30 this afternoon and to southerly 15 to 25 this evening. Winds increasing to southerly winds 25 to gales 35 overnight and to northwest gales 35 to 45 Thursday afternoon. Flurries ending this afternoon. Snow beginning Thursday morning then tapering to flurries Thursday afternoon. Visibility fair to poor in precipitation. Freezing spray ending this evening. Freezing spray beginning Thursday afternoon. Temperatures near minus 7 rising to near minus one overnight then lowering to near minus 7 Thursday afternoon.

Outlook for Friday ... strong northwesterlies diminishing to light to moderate northerlies.

However, on the same day, Wednesday, December 6, 1989, a low pressure system was analysed by Environment Canada as moving eastward across the province of Ontario and into Quebec. (See weather charts contained in Annex 1.)

There were strong indications that the low would deepen quickly as it passed over the Gulf of St. Lawrence; consequently, a storm warning was issued by the Maritimes Weather Centre at 1600 and broadcast at 1610, Wednesday, December 6, which stated as follows:

Storm Warning

Attention Fishermen and Marine Interests

Fourchu
Banquereau
Cabot Strait
Northumberland Strait
Gulf Magdalen
Chaleur Miscou
Anticosti

An area of low pressure approaching from the Great Lakes will develop into an intensifying low pressure centre just south of New Brunswick Thursday morning. The low will then track northeast across the Gulf of St. Lawrence. Northwest gales of 50 to 55 knots will develop in the wake of this low over the northern marine areas on Thursday. Further details follow in the 5.00 PM marine forecast.

The marine forecast which followed at 1700 expanded upon the storm warning as follows:

Cabot Strait
Eastern Half of Gulf Magdalen
Gale warning upgraded to storm warning.
Freezing spray warning continued.
Winds southwest 20 to 30 knots increasing to
southeast gales 35 to 45 overnight and to westerly
gales 44 to 55 Thursday afternoon snow beginning
Thursday morning tapering to flurries Thursday
afternoon. Visibility fair to poor in precipita-
tion. Freezing spray tonight and Thursday.
Temperatures near minus 5.
Outlook for Friday ... gale force westerlies
diminishing to strong westerlies.

Further scheduled forecasts, broadcast at 6 hour intervals up to and including the time of the "CAPITAINE TORRES" sinking at 0327, Friday, December 8, followed a similar pattern but showed that winds were expected to increase in velocity to some 60 knots gusting to 70 knots.

3. Weather reports received on board

Eastern Canadian marine weather forecasts are broadcast by radiotelephone at regularly scheduled times and in addition, if necessary, revised forecasts or warnings are issued as required.

Details of radio stations and the frequencies, times of transmissions, etc., are contained in the Canadian Coast Guard publication TP146E entitled, Radio Aids to Marine Navigation; however, forecasts can be obtained from radio stations at any time, on request.

The last persons to see and speak to the crew of the "CAPITAINE TORRES" were the two Canadian pilots who had conducted the navigation of the vessel from Quebec Harbour, Quebec, to Les Escoumins, Quebec. They had joined the vessel at 1534 on December 5 and left it at Les Escoumins at 1610, December 6, the vessel having been delayed due to the necessity to anchor overnight because ice floes in the river had displaced many of the navigation buoys.

During the 24 hours that the pilots were on board, the weather conditions in the sheltered reaches of the river were good and on several occasions the two pilots discussed the procedures for obtaining weather forecasts and sea ice conditions with the master and first mate. These discussions were carried out

in both French and English and it seems that the master and first mate had an excellent ability in both languages, as did the two pilots whose natural language is French.

It is not known whether the vessel had received the weather forecasts, but neither the master nor the first mate indicated concern over the weather to be expected and it was known that the Gulf was free of ice. The pilots left the vessel at 1610, which was at about the time the subsequent storm warning was first broadcast; by 1700, the time of the next scheduled forecast, the vessel had left the pilotage station and had proceeded independently for some 50 minutes; therefore, it is not known if the storm warning was received on board.

4. Charts, publications and ECAREG

The Canadian Charts and Publications Regulations are made pursuant to the Canada Shipping Act and require vessels to have on board and maintain the appropriate up-to-date charts and publications for the areas to be navigated. (See Annex. 2)

As required by the Eastern Canada Vessel Traffic Services Zone Regulations (ECAREG), the "CAPITAINE TORRES" had reported her estimated time of first arrival at the entrance to the zone while enroute from Emden, West Germany, on November 9, 1989, and provided all of the required information (see Annex 3), which included the information that there were no defects in the ship's hull, main propulsion machinery, steering system, etc., but that she carried only British Admiralty charts; there was no mention of publications, consequently, both the vessel and her appointed agents at Montreal were advised by ECAREG of the necessity for up-to-date charts and publications.

The following were placed on board the vessel when she arrived at the pilot station at Les Escoumins Quebec, on November 12, 1989:

- a) All appropriate up-to-date United States and Canadian charts for the areas to be navigated, which amounted to 50 charts.
- b) All appropriate publications amounting to 12 which included:

Canadian Hydrographic Services - Sailing Directions, Gulf and River St. Lawrence, 1989.

Canadian Coast Guard - Notices to Mariners, Annual Edition, 1990.

Canadian Coast Guard - Radio Aids to Marine Navigation, Atlantic and Great Lakes, 1990.

Consequently, it is known that publications containing the appropriate information regarding seasonal weather, weather forecasts, etc., and radio stations and communications procedures had been on board for at least 23 days at the time of the vessel's final departure from Les Escoumins pilotage station on December 6, 1989.

5. Storm centre relative to "CAPITAINE TORRES"

The low stalled when just east of the Strait of Belle Isle (Newfoundland) on December 8, with a central pressure of about 962 millibars. It had passed in a direction from south-west to north-east across the Gulf of St. Lawrence during December 7; comparison of the weather system maps produced by Environment Canada and the known times and positions of the "CAPITAINE TORRES" during December 7 indicate that the centre of the system would have passed some 40 miles ahead of, and across, the course line of the vessel at 1400 on December 7.

6. Propulsion machinery condition, recent history and chronology

Available information shows that the propulsion machinery and its ancillaries had been maintained to the standards required by the Classification Society until the time of the surveys carried out by them in October 1989. However, other later information shows that there had been a number of main-engine and other machinery problems experienced by the new crew from the time they joined the vessel.

Reportedly, a maximum of some 5 hours had been available for the new engine-room crew to meet with the previous crew during the change-over period and to assimilate their knowledge and experience; however, other information shows that a total of 7 days had been available to the relieving chief engineer and crew to assimilate the knowledge and experience of the previous chief engineer before he left the vessel and that the hand over was completed in a professional manner.

The vessel experienced a variety of main engine and auxiliary machinery problems during the passage across the North Atlantic from West Germany to Canada, including:

a) November 1, 1989, part of a fresh water evaporator chamber blown out over an area of 15 cm square - intention to repair on arrival U.S.A.

b) November 7, 1989, a main engine bearing badly scored - removed and spare fitted while at sea; one spare remaining.

The vessel arrived at Burns Harbour, Illinois, U.S.A. on November 18, 1989, where she completed loading and then departed for sea on November 26, 1989. During the time at Burns Harbour the crew overhauled the main engine cylinder heads and cracks were found in two of them which were repaired. In addition, there were problems with the air compressors and with the lubricating oil pumps for which there were no spares on board and which were repaired by the crew. The services of shore-based engineering companies were not used, neither was the United States Coast Guard nor the vessel's Classification Society advised; therefore, there are no specific records of the repairs carried out, nor is there a Classification Society report.

A spare cylinder head, plus spares for the compressors and oil pumps, were requested by the vessel from Burns Harbour to be sent to Panama for delivery to the ship while enroute to Taiwan. The ETA at Panama, had the vessel maintained 14 knots, would have been some 20 days after departure Burns Harbour on November 26, which would have been on, or about, December 16, 1989.

Shortly after leaving Burns Harbour on November 26 and while navigating the Seaway and Great Lakes pilotage areas, the vessel's main engine was stopped due to a reported air-compressor breakdown for a period of some 6 hours. During the rest of the pilotage the main engine was periodically run at reduced revolutions, particularly during times when changes of engine speed were quickly, required to safely navigate channels etc. Reportedly this was due to the main engine overheating.

Although equipped for direct bridge (wheel-house) control, the main engine was operated by engine-room staff in response to orders transmitted via the direct control system, as reportedly the main engine pneumatic controls on the bridge were inoperative.

The main engine could be manoeuvred via the following:

(a) Pneumatic controls on the bridge;

- (b) Pneumatic controls in the engine-room control-room;
- (c) Manual controls at the emergency manoeuvring platform in the engine-room.

It is not known from which station the main engine was controlled during the period prior to the vessel's loss, however it is known that all three systems were demonstrated to the new crew in Emden and all were operating satisfactorily at that time.

Air for the controls had a working pressure of 7 bars and when it fell to 5.5 bars an alarm sounded to ensure that the pressure was brought back to 7 bars by the engineer, if the main compressor failed to start automatically. However, the controls remained functional even at 4 bars. The vessel was equipped with two main air receivers (bottles) with a capacity of 3000 litres each and one auxiliary receiver with a capacity of 200-250 litres. Both main and auxiliary receivers and the reducing station had a working pressure of 30 bars. The air-receivers were the main source of air supply, with a reducing station which allowed the air pressure to be dropped from 30 to 7 bars. Any breakage of pipe between the air receivers would have rendered both (a) & (b) controls inoperative but the main-engine would have remained operative and manoeuvrable from the manual emergency position in the engine-room. Any breakage in the pipe between the switchover valve and the bridge control would have made only (a) inoperative. Pneumatic systems operated on a single pipe and each station had both telephones and ship's telegraph for communications and an emergency stop for the main engines.

The main engine, due to fixed-pitch propulsion, was of a type that required to be stopped when being changed from the ahead to the astern mode and vice versa and it was found on many occasions when ordering movements following stop modes, it would take as long as 5 to 8 minutes before the engine would respond, reportedly due to a lack of starting air and which required the vessel to undertake repairs to the system while stopped in a lock in the St. Lawrence Seaway.

It was not necessary to stop the main engine to carry out repairs to air compressors, collectors or piping once the vessel had cleared the pilotage station outbound because there was no longer an immediate requirement for manoeuvring, and therefore starting air.

The first indication to the Canadian Coast Guard that the "CAPITAINE TORRES" was experiencing major propulsion/mechanical problems was during a VHF radiotelephone call to CGRS

VCO at Sydney, Nova Scotia. The call, which commenced at 1936, December 7, 1989, informed VCO that part of the vessel's deck cargo had been lost overboard and that the vessel had taken a 2° list to port. It was also advised that the vessel would be stopping for unspecified main engine repairs which were expected to require about three hours. It was further indicated that there were problems with the vessels air compressors.

The vessel advised that she had stopped her main engine at 1952.

At 2029, the vessel reported to VCO that she would remain stopped for at least two hours, that her list had increased to 10° to port, and that difficulty was anticipated in re-starting her main engine due to this list. At about 2045, in a VHF radiotelephone link-call to the vessel's managers in New Zealand, it was confirmed that the main engine was still stopped due to problems with the air compressors, and unspecified lubricating oil problem and that difficulty was anticipated in re-starting her main engine due to the vessel's list.

The vessel's main engine lube oil sump, approximately 4 m wide by 7 m long, was located under the main engine and according to the vessel's previous chief engineer had contained its normal capacity of 6,500 litres of lubricating oil on the vessel's departure from Emden. It was also reported that her lube oil tanks were full at this time. Reportedly the vessel had not experienced list problems while the previous chief engineer served aboard, a period of about eight years, therefore no information was available on the angle of list at which lube oil suction problems were experienced with either the main engine or auxiliaries. The content of the main engine lube oil sump at the time of the casualty is unknown.

By 2135 the vessel's list had increased to 10° to 15° to port, and she would have been rolling heavily.

At 2211 the vessel reported to VCO that work was in progress on an air compressor which "should be going in about half an hour", after which some of the main engine starting air bottles were to be filled and it was hoped that the vessel would "get going" in about one hour's time.

In a further radiotelephone link call with New Zealand at about 0007, December 8, the vessel reported that her list was now 15° to port and that one of her air compressors was "out" due to crankshaft or bearing problems. This compressor was

stated to be unserviceable and irreparable on board, due to crankshaft damage. It is not known if this compressor was unserviceable when the vessel departed Burns Harbour, but a new crankshaft and lubricating oil pump had been ordered during the vessel's stay there, and had reportedly been shipped to Panama to await the vessel's arrival en route to Taiwan.

It was further reported during this conversation that the other air compressor had been "put together" (presumably after having been dismantled for repair) and that difficulty was being experienced in restarting it due to "some problem in the lubricating oil in the air compressor. However it was stated that the compressor had been put back into service after repair and air pressure was starting to rise. Problems were also being experienced in keeping the vessel's auxiliaries running due to the 15° list.

At 0036 the vessel reported to VCO that the "compressor is running but there is some (air) leak at the moment", and it was repeated that (the vessel) would be under way in about half an hour.

At 0104, the vessel reported to VCO that air pressure was not building up enough to start the main engine, that more deck cargo had been lost overboard and that her list had increased to 20°. Further deck cargo was lost at 0109 increasing the list to 35°. At 0115 the vessel reported to VCO that there was no prospect of starting the main engine for another hour and that the list had decreased to 20° to port after a further loss of deck cargo.

The main engine was restarted at 0146, December 8 and the vessel proceeded at an estimated speed of 5 knots while listed 20° to port with the wind and seas astern, but at 0219, some 33 minutes later, the main engine once again stopped apparently due to lack of lubricating oil brought about by the list now reported to be 25°.

At 0227 the vessel reported to VCO that there was "no water in the hatch so far pumping bilges every hour to make sure and there is no water in the hatch so far ...".

In a conversation with New Zealand at 0234 it was confirmed that the main engine was again stopped, ".... with the list it can't keep up the oil pressure..", and "I'm losing generators at the moment". It was also stated that "not sure if main engine can be restarted". It was further stated during this conversation that "we have problem after problem with the main engine The air compressors, there isn't any

separate circuit for the pneumatic engine controls, there's nothing to back them up when the engine is stopped - there's not much safety back up."

Between 0250 and 0255 the vessel suffered an electrical blackout probably due to generator prime mover failure brought about by the lack of lubricating oil pressure and the vessel's list, but no report was made as to the reason for the failure. From then on, until sinking at 0327, there were no further engine movements.

In summary, the problem with the main engine, which necessitated stopping the vessel, was not, at any time, identified. There is evidence that severe problems were experienced with the vessel's compressed air system which delayed the re-starting of the main engine. However, the loss of compressed air for the pneumatic engine controls, would not oblige the vessel to stop her main engine, as an alternative non-pneumatic system emergency control system was in place.

7. Classification Society Rules

The General Rules and Instructions of Germanischer Lloyd (the vessel's classification society) state that, as a minimum requirement, a vessel's main and auxiliary machinery must continue to operate when the vessel has a permanent list (an athwartships angle of inclination) of 15°. These rules further require that such machinery continue to operate while the vessel is rolling (athwartships dynamic angle of inclination) up to 22°5. Emergency machinery must continue to operate when the vessel is rolling or listing up to 22.5°.

While the above may explain the difficulties encountered in restarting the main engine and auxiliaries when the vessel was listing more than 15°, it does not explain why the main engine stopped when the vessel was listing 2°; the cause of the first stoppage remains unknown.

The "CAPITAINE TORRES" had frequently traded into German ports where Classification Society surveyors were always available to carry out ongoing inspections and maintain the vessel in Class. However, during the final voyage, no advice was provided to the Classification Society regarding any of the mechanical problems encountered while en route to Burns Harbour or when outbound through the Seaway and River St. Lawrence systems.

8. Cargo loading, stowage and securing

The vessel had arrived at Burns Harbour while in ballast in order to load a full cargo consisting of many parts of a steel mill which had been disassembled and packaged in various crates, boxes and containers, also on pallets and as single unprotected pieces, totalling some 1,270 separate items.

The loading and securing of the cargo which was stowed underdeck was carried out by a local stevedore company under the guidance of the master together with a cargo superintendent who acted on behalf of the charterers.

Photographs of the cargo stowage which were taken as the loading progressed indicate that, as is usual, the cargo was secured and protected by the use of wooden dunnage and further secured by wire and chain lashings. It appeared to be well secured with each hold being stowed full to the hatch coamings as solidly as the various sized packages and pieces would allow.

The underdeck stowage had not increased the vessel's draught to that allowed by her winter loadline mark plus the allowance for freshwater density and loading port location, therefore, it was decided to load to that draught by taking further cargo on deck.

The deck cargo consisted of three portable control rooms, nine metal containers and numerous uncrated steel mill parts, having a total weight of some 389 tonnes. The 6 m long portable control rooms were stowed on number two hatch, while five 10.66 m long containers and some of the uncrated steel mill parts were stowed on number three hatch. Four 6 m long containers, together with the remaining uncrated steel mill parts, were stowed on the weather deck to port and starboard of numbers two and three hatches.

The securing of the deck cargo was undertaken by the ship's crew at a time after the loading had been completed and the stevedores had left the vessel; consequently, it is not known what securing arrangements were actually made. Reportedly, it was the intention to secure the control rooms and containers in the accepted manner; i.e., by the use of chain and wire lashings, stretched diagonally from each of their top four corners and secured to the hatches and decks. Each lashing was to be independent and fitted with turnbuckles to facilitate tightening during the voyage; chain and wire lashings were also to be used on the other deck cargo.

A Certificate of Release was provided by the "CAPITAINE TORRES" shortly before departure from Burns Harbour which stated in effect that the cargo had been loaded, stowed and secured in every respect and that the vessel was ready to depart.

The release was dated November 26 at 1900, whereas the stevedores left the vessel at 1700; therefore, it seems the securing of the deck cargo by the vessel's crew occurred during the intervening 2 hours.

A video tape recording of the St. Lawrence River ice conditions, which happened to show the vessel during her passage through the river system, shows the containers and control rooms on the hatches but does not clearly indicate the lashings or any other securing arrangements; therefore, their precise arrangement cannot be confirmed.

Efficient securing of deck cargo is of importance due to the cargo's exposure to weather conditions and the impossibility of obtaining a compact stow, such as for cargo stowed in holds. In particular, when a vessel is broken down and there is therefore no control over her direction, speed, and motion, the importance of a secure stow is paramount in order to resist the forces imposed by the prevailing seas.

The vessel's initial list appears to have been caused by the loss overboard of the three control rooms from number two hatch and the shift to port of other deck cargo, followed by the further shift and loss of containers from number three hatch, together with a shift of hold cargo.

A possible explanation for the movement/loss of some crated/boxed cargo could be the failure of the crate or box itself within the securing arrangements.

Such movement of cargo could have caused damage to the weather deck, deck fittings such as double bottom airpipes, ventilators, hatch covers and coamings, thus allowing water shipped on deck to downflood into the holds and progressively increase the list and reduce reserve buoyancy.

9. Stability

Reportedly, the vessel was loaded to a mean fresh water draught of approximately 7.90 m and trimmed 6 cm by the bow at departure from Burns Harbour. She was upright with no discernible list and during the passage through the Great Lakes and Seaway gave the impression to various pilots that her stability was very positive (stiff), which is indicative

of high initial stability. It should be noted that 8 hours elapsed from the time of the loss of main engine power to sinking, during which time cargo had shifted to port and decks and fittings may have become damaged, thus allowing downflooding into the hull.

Because the vessel's trim and stability booklet and all departure loading calculations were retained onboard the "CAPITAINE TORRES" when she departed from Burns Harbour, her precise deadweight distribution and departure stability characteristics are not available. Furthermore, no copies of her basic design or trim and stability data were retained in the owners' or builders' records; consequently, a post-casualty stability analysis has been made based on owners' supplied lightship and tank capacities data from the "CAPITAINE DAMPIER"; a sistership built concurrently to the same design at the same shipyard.

Reportedly the "CAPITAINE TORRES" was loaded to a mean fresh water draught such that, after passing through the Great Lakes and Seaway and on entering the Gulf of St. Lawrence, her mean salt water draught would comply with her assigned Winter Load Line of 7.689 m. In order to attain the maximum cargo deadweight, only the minimum quantity of water ballast required to ensure trimmed draughts necessary for lock and canal transit was loaded in conjunction with the oil fuel and stores required for the first part of the intended voyage.

On departure from Burns Harbour the vessel was upright; her mean fresh water draught was 7.9 m and she was trimmed 6 cm by the bow. Reportedly she was loaded with some 392.5 tonnes of heavy oil fuel, 143.6 tonnes of diesel oil and a total of 180 tonnes of fresh water and trimming ballast. After due allowances for lubricating oils, stores, cargo lashings and dunnage, etc., hydrostatic analysis of the recorded draughts indicates a total cargo deadweight of some 7,684 tonnes. The cargo stowage plan retained by the cargo consultants indicates a deck cargo deadweight of some 389 tonnes and a distribution generally similar to that shown on the video recordings taken as the vessel was transiting the St. Lawrence Seaway.

Calculations based on the deduced deadweight details and sistership lightship characteristics show that, on departure from Burns Harbour, the vessel's transverse stability complied with International Maritime Organization (IMO) and Canadian Coast Guard (CCG) regulatory intact stability requirements for dry cargo ships. Her transverse stability was such that, on entering the Gulf of St. Lawrence, her metacentric height (GMT) and maximum righting lever (GZ), exceeded the regulatory requirements by 800% and 240% respectively. It should be

noted that the regulatory criteria represents minimum requirements with no upper limits having been set and that while transiting the St. Lawrence Seaway the vessel gave several pilots the impression that her stability was very positive and 'stiff'.

Such 'stiffness' induces a relatively short rolling period; pitching and rolling in confused seas can produce accelerations which result in excessive stresses on cargo lashings and cargo crating, and these accelerations may lead to longitudinal and lateral shifting of stowed cargo. In this instance the relatively high initial transverse stability was unavoidable due to the nature, weights and stowage characteristics of the many individual items of the dismantled steel mill cargo; loss of deck cargo and shifting of underdeck cargo was reported by the disabled vessel prior to her sinking.

Post-casualty analysis shows the heeling moment due to the initially reported loss and shift of deck cargo was insufficient to cause the related heel of 2°, and that such an angle would only be reached with an additional heeling moment equivalent to all of the underdeck cargo shifting 0.05 m to port. After due allowances for the progressive loss and shift of deck cargo, the reported transfer of existing fresh water ballast to starboard and the effects of ice accretion, a further heeling moment equivalent to all of the underdeck cargo shifting 0.5 m to port would be required to induce the reported heel of 15°. Such a shift of all of the underdeck cargo is considered unlikely, and the movement of only parts of the cargo necessary to induce the same heel would require proportionately greater athwartship shifts and is therefore considered even less likely. Consequently, while it is recognized that some shifting of underdeck cargo did occur, it is also considered that the vessel's hull did not remain intact and that her transverse stability was concurrently reduced by the free-surface and heeling effects of downflooding into numbers two and/or three 'tween decks and holds by way of damage on the port side of the weather deck, incurred when the deck cargo shifted. It is also possible that flooding of numbers two and/or three 'tween decks and holds also occurred simultaneously as a result of undetected under-water damage to the side shell plating, caused by shifting underdeck cargo.

The master reported that there was no water in the holds; however, soundings would not have been possible in the prevailing weather conditions.

In summary, it would appear that the disabled "CAPITAINE TORRES", having initially taken on a slight heel because of a loss and shift of deck cargo, progressively lost transverse stability due to the free-surface and heeling effects of an ingress of water resulting from hull damage caused by shifting cargo. The angle of heel increased as the downflooding progressively reduced her righting ability and overcame her reserve buoyancy; it is uncertain whether or not she completely capsized before foundering.

10. Effect of list on seaworthiness

Two major factors in the range of a ship's stability and seaworthiness are the effective breadth of the uppermost watertight deck, which in the case of the "CAPITAINE TORRES" was the weather-deck, together with the height of the deck above the sea surface (freeboard).

Based on an estimated intact mean freeboard of 2.9 m, calculations show that the deck edge would immerse when the vessel listed, heeled or rolled to angles of more than 16° from the upright. By the time the list had increased to 40° the port side of the weather-deck would have become immersed in the sea for approximately 30% of its breadth, amounting to 6.53 m.

The above applies to a vessel at rest in still water; however, in the case of the "CAPITAINE TORRES", the motion of the vessel in the seas; i.e., rolling, pitching and heaving, would have frequently immersed the deck to a greater extent. This is borne out by the recorded communications with the vessel which indicate the seas to have been washing at times over half of the breadth of the deck and hatches. Consequently, any damage on the port side of the deck would have been frequently or continuously immersed, and downflooding would have occurred.

Furthermore, handling and steering characteristics are adversely affected when a vessel is heavily listed, and in this instance effective control, even while main engine power was available, would have been significantly reduced in the storm conditions prevailing prior to the sinking.

11. Ice Accretion

Radiotelephone communications from the vessel prior to the sinking indicate that ice accretion due to the weather was not a significant factor in the vessel's loss.

Although the extent of accreted ice is not known and its distribution and weight cannot be precisely calculated, its total weight and combined centre of gravity can be estimated from data provided by the many studies which have been made on the subject.

Ice accretion occurring to vessels under the reported weather conditions would have been caused principally by sea spray and is mainly dependent on the following factors:

- a) the climatic conditions,
- b) form and size of vessel,
- c) speed and direction of the vessel relative to the wind and seas.

The many variables involved in calculating ice accretion make it a very uncertain science, however, the known factors are that the "CAPITAINE TORRES" was stopped and drifting with the wind and weather on the starboard side while she was listed to port. The climatic conditions, as recorded by Environment Canada, affecting the "CAPITAINE TORRES" and other vessels in the area, were:

- a) air temperature minus 3°C,
- b) sea temperature plus 3°C,
- c) wind speed, Beaufort scale 10; i.e., 48 to 55 knots.

From the ice accretion tables contained in the Annex to this report, it can be seen that ice accretion to the vessel could have been approximately 1.0 to 1.5 cm thick before she sank. This thickness of ice covering the exposed half of her weather decks on the starboard side and also up to half of the height of the accommodation, deckhouses, rails and deck fittings on that side, would have an estimated weight of 53 tonnes and a combined centre of gravity of some 14.53 m above the keel.

This additional weight would have raised the vessel's centre of gravity, contributing only slightly to the reduction of transverse stability, and its total effect in this instance is considered to have been relatively insignificant. However, the presence of any ice in way of lifesaving appliances adds to the hazards of abandoning ship, and could have led to the loss of one of the liferafts while launching was being attempted.

12. Classification society surveys, and apparent general condition

The vessel completed her Classification Society survey during the transfer to the new owners in October 1989, less than 2 months prior to sinking, and had retained her class; consequently, her seaworthiness as regards the hull and machinery was considered to have been satisfactory by the Society at that time, given the normal usage and stresses expected while at sea. There are no records of the Society having received reports of the subsequent series of engine breakdowns and repairs and no further inspections were carried out by them. It must be noted that a Classification Surveyor can only attend aboard a vessel by invitation. Reportedly Vanuatu is negotiating with the principal Classification Societies to accord random inspection facilities to these societies.

It would seem that the decks, hatches and hull of this 11 year old vessel were in a condition commensurate with her use in a trade requiring the loading and unloading of heavy general cargoes. The 'tween deck steel pontoon hatches and double bottom tank tops were reportedly dented in places and the condition of the weather deck hatches and coamings was described as being fair.

During the Great Lakes and Seaway pilotage, it had been observed that the wheel-house deck-head was leaking in various places requiring the use of buckets and other containers to collect snow and ice water which dripped onto the deck. It was also observed that the wheel-house heating system was inadequate.

13. St. Lawrence Seaway Authority Reports from the Vessel and Inspections

In accordance with standard procedures, when the "CAPITAINE TORRES" first arrived at Montreal on November 14, 1989, while enroute to Burns Harbour, she was boarded by an Authority inspector who, after determining her capability to safely navigate the Seaway system, issued a certificate to the effect that she could complete the inbound and outbound voyage.

The subsequent grounding in Lake St. Francis and the malfunction of the main-engine air-starting system both occurred in the Seaway while outbound after leaving Burns Harbour and both were reported to the Authority.

In the case of the grounding, the vessel was allowed to proceed on the basis of her report covering the event together with her report on the results of an inspection which gave the indication of no apparent damage to hull or machinery. In

addition, the Authority subsequently monitored the vessel's draught at each lock and inspected the water in the locks to detect possible fuel oil leakage, finding no cause to detain the vessel.

In the case of the air-starting system malfunction, this was reported and repaired while the vessel was in a lock and an Authority inspector attended. The system was subsequently tested to his satisfaction and the vessel was allowed to proceed.

With regard to the engine overheating problems, one occasion was reported to the Authority and apparent satisfactory repairs were made by the crew. However, this condition was reportedly due to a faulty exhaust valve and therefore cannot be attributed to low lubricating oil pressure.

14. Pumps

When the aircraft arrived at the position of the "CAPITAINE TORRES" and asked if extra pumps were required, the vessel replied to the effect that additional pumps would be of no assistance. Prior messages to VCO had indicated that the vessel's bilge pumps were coping with any ingress of water to the holds; the engine-room remained dry and the situation was one where there was no indication of the vessel sinking. As a result, the aircraft was directed to proceed to the "JOHANNA B" who had declared a Mayday and was in immediate danger of sinking.

Canadian SAR aircraft drop pumps to vessels by flying as low as possible, releasing a line which falls across the vessel and then parachuting an attached canister containing a pump into the sea; the line is then used by the crew to haul the pump on board.

At that time, the situation on the "CAPITAINE TORRES" was one where she was listing some 15°, rolling heavily and seas were washing onto the maindeck, making underdeck access for inspection by the crew too hazardous. There was no means of access to the holds for the pumps other than from the maindeck access hatches and, had the crew been able to gain entry, the portable pump suction could not have been led to the bottom of the holds because of obstructions from the stowed cargo. Furthermore, while below, the crew would have been at great risk in the event of a further shift of cargo due to the ship's heel and motion.

It follows that under the circumstances, the additional pumps could not have been used for pumping water from the holds.

15. Wind chill factor

Wind chill factor is a measure of the combined chilling effect of wind and temperature.

As a result of studies which have been made on the subject, Environment Canada has produced information and tables intended as a guide for persons likely to be exposed to strong winds and low temperatures.
(See Annex 4.)

It can be seen from the tables that in the conditions experienced by the "CAPITAINE TORRES"; i.e., air temperature minus 3°C (plus 27°F) and a wind velocity exceeding 50 mph, then the wind chill factor would reduce the equivalent air temperature to less than minus 21.7°C (minus 7°F).

The information states in part:

.... It is important to realize that the wind chill concept applies only to human beings.....

It follows that adequate clothing is of paramount importance for persons exposed to such conditions and that the periods of exposure are kept to a minimum.

It seems that the clothing worn by some of the vessel's crew was adequate for the Canadian winter climate as they were seen during the pilotage to be wearing insulated coveralls, known locally as snowmobile suits, together with woollen hats and gloves. However, when the wearer of a garment such as a snowmobile suit is immersed in water, or from any other cause it becomes saturated, then it will no longer retain its insulation properties.

16. The lifejacket recovered from the Gulf of St. Lawrence

The lifejacket apparently met the standards required by the International Safety of Life at Sea (SOLAS) Convention 1983 and had an outer casing constructed of a plastic material with internal buoyancy consisting of expanded polystyrene (styrofoam). It was found by a local fisherman some 5½ months after the "CAPITAINE TORRES" had sunk. It was floating, while partially submerged, in a position off the east coast of the Magdalen Islands, some 50 miles from the position of the vessel's sinking. Due to the time period of exposure to the sea and weather, the markings on the jacket had become considerably degraded; however, the name "CAPITAINE TORRES", which had been superimposed over the vessel's former name of "SUNNY ISABELLA", was still clearly visible; other markings

on the jacket were not decipherable. A piece of blue coloured cloth was tied into the knots which had been made in the securing tapes and appeared to be the remnants of outer clothing such as coveralls, which indicated that the jacket had been worn. (For an excerpt of the SOLAS (1974) regulations, headed "Regulation 22, Lifejackets", see Annex 5).

A series of tests made on the cloth and the lifejacket at a forensic laboratory, together with the evidence of experts in the use and properties of plastics, showed that the cloth consisted of a woven cotton fabric which is in widespread use in the production of work clothing such as coveralls and was not part of the lifejacket. The buoyancy material contained in the lifejacket was in fact styrofoam which had compacted to approximately 12% of its original volume but had retained its approximate original form, which indicates that it had been subject to an equal and opposite pressure of some 500 lbs per square inch, commensurate with a pressure of water at the depth in which the vessel had sunk. This evidence shows that the wearer had not cleared the vessel but had sunk with it, which in the position of sinking is some 200 fathoms (366 m) deep. It seems that the jacket had later cleared itself from the wreckage and floated free.

17. Survival suits and lifejackets

Various types of suits are specifically designed to protect the wearers from the effects of cold water immersion and therefore hypothermia and also to provide buoyancy. They are commercially available, however, at the time the "CAPITAINE TORRES" sank, they were not required by regulation to be carried on board all commercial vessels and none was carried on the "CAPITAINE TORRES".

The visibility was such at the time of sighting the occupant, or occupants, of the liferaft that the clothing could only be described as being dark in colour, which indicates the absence of lifejackets which were of the standard orange colour. It should be borne in mind that the buoyancy material contained in lifejackets also provides the wearer with a degree of insulation.

There were 36 approved lifejackets on board which were sighted during the surveys carried out by the Classification Society at Emden in October 1989; thirteen unoccupied lifejackets were seen floating in the sea by the "SIR WILFRED GRENFELL" during the search which means the balance of 23, the same number as the total crew, were, at that time, unaccounted for. It is not known whether all of the crew had donned lifejackets prior to abandoning; it is only known that no survivors or their

remains were found during the very extensive search. At least one person had been unable to evacuate the vessel and had sunk with it while wearing a lifejacket.

18. Hypothermia and survival time

A Canadian Red Cross Society pamphlet entitled 'Cold Water Survival' graphically illustrates the survival time for adult persons who are wearing standard approved lifejackets, are lightly clad and holding still in ocean water. (See Annex.) In the prevalent seawater temperature of plus 3°C, such persons have a strong possibility of survival if rescued within 20 minutes. Between 20 minutes and 80 minutes of immersion, the persons will become weak and unable to help themselves. After 80 minutes, death will occur.

Taking into consideration that:

- the seas were extremely rough, reaching heights of up to 5 m, and

assuming that:

- crew members who did not occupy the liferaft were heavily clad in winter clothing and boots and might not have been wearing lifejackets or any other form of personal flotation device.

It is highly unlikely that they would have remained afloat for any significant period of time and consequently their survival time would have been minimal.

With regard to the persons who had occupied the liferaft, considering that the equivalent air temperature was approximately minus 22°C, the protective canopy had not been closed and the raft was therefore open to the wind and sea spray, their survival would have been minimal even if they been able to remain on board. However, it appears they did not secure themselves within the raft, that the canopy collapsed, and that they may have been ejected by the raft's motion and become immersed in the sea.

19. Fatigue and cold factors

During the 8 hours prior to attempting to abandon, the crew had all been awakened and had eventually assembled on the navigation bridge (wheel-house). During most of this time the main engine had been stopped and the vessel was uncontrollable with the consequent extremes of motion in the seas.

The heating system throughout the vessel was said to be inadequate, therefore, both the vessel's motion and lack of heat would have contributed to the crew's fatigue, to seasickness and to a lack of alertness and therefore the ability to safely abandon.

20. Method and time of abandoning

The master occupied the navigation bridge (wheel-house) for most of the 8 hours which elapsed between the time of the initial main engine stoppage and abandoning, where he had direct access to the radiotelephone and which served as the most appropriate place from which to monitor the engine repairs and the vessel's seaworthiness and safety conditions.

During the latter part of that time, the rest of the crew had assembled in the wheel-house and therefore were immediately available when the decision to abandon was made.

As indicated from the radiotelephone communications with the "SIR WILFRED GRENFELL" the initial intention was for the 23 crew members to abandon via the two, 16 person, inflatable liferafts. The rafts having been launched and inflated, one broke free from the vessel and floated away in the extreme weather conditions before it could be boarded by any of the crew, which left the one 16 person raft and the two lifeboats. The decision was then made to use the remaining liferaft and to launch the lifeboat on the port (leeward) side.

It would appear from the context of the last radiotelephone message at 0326, together with the loss of the target from the radar screen on the "SIR WILFRED GRENFELL" approximately one minute later, that the "CAPITAINE TORRES" situation had deteriorated to one where the list to port had increased to 40° and the vessel was rapidly sinking while the radiotelephone call and abandonment were being carried out.

The appropriate time at which to make a decision to abandon a ship must rest with the person holding the responsibility for the safety of the crew, in this case the master. Such a decision must be made taking into account all of the existing factors and risks. The master of the "CAPITAINE TORRES" chose to stay on board the vessel for as long as possible while assistance was approaching and the vessel remained afloat and stable, rather than risk the crews' safety to lifesaving appliances in the prevalent sea and weather conditions.

It cannot be ascertained whether or not an earlier decision to abandon would have been wholly or partially successful, however, there have been many past incidents where premature

abandoning has led to loss of life while the vessel has remained safely afloat, leading to the general safety rule 'stay with the ship'.

21. Drills, emergency and abandoning ship

Reportedly, there is no requirement within the context of the Vanuatuan Maritime Act regarding the exercising of ship's crews in the safe abandonment of Vanuatuan registered vessels but, in 1982, Vanuatu acceded to the International Maritime Organization, 1974 SOLAS Convention and to the 1978 SOLAS Protocol.

Regulation 26 of the 1974 SOLAS Convention and Protocol of 1978, entitled Practice Musters and Drills, requires that in cargo ships a muster of the crew shall take place at intervals of not more than one month and a muster shall take place within 24 hours of leaving port if more than 25 per cent of the crew have been replaced at that port.

A resolution of The International Conference on Training and Certification of Seafarers, 1978 recommends that seafarers, before being employed on a sea-going ship, receive approved training in personal survival techniques, including getting the survival craft quickly clear of the ship, protection against cold or extreme heat and in the proper operation of survival craft equipment.

Regulation 18 of Chapter III of the SOLAS Convention 1974, the SOLAS Protocol of 1978 as amended in 1981 and 1983, requires that on board training be given in the use of a ship's life-saving appliances, first aid procedures, the first-aid treatment of hypothermia and that special instruction be given for the use of ships life-saving appliances in severe weather and severe sea conditions.

The 1974/1978 Solas Convention does not contain such regulations or resolution and at the time the "CAPITAINE TORRES" sank Vanuatu had not acceded to either STCW 1978 or to the SOLAS amendments of 1981 and 1983.

Reportedly, a crew muster at emergency and lifeboat drill was carried out while the vessel was at Emden prior to departure for Canada, which was witnessed by a Classification Society surveyor; however, it is not known to what extent the crew were instructed and exercised at abandoning ship using inflatable liferafts and wearing approved lifejackets. Neither is it known if subsequent exercises and drills were held.

Reportedly, the owners' policy was to equip each vessel with the appropriate directives and video training aids.

22. The Search and Rescue (SAR) initiative

Canadian SAR procedures are generally initiated by vessels which require immediate assistance and which have specifically requested that assistance in the form of an internationally recognized signal such as a radiotelephoned Mayday, Pan or Securite message.

Experience has shown that masters of ships are often reluctant to declare these messages at an early stage, a reluctance which is apparently due to a number of factors which include, a reticence to launch a massive SAR mission, with its associated effort and cost to the SAR organization, or the failure to realize that an adverse onboard situation cannot be handled by ship's personnel alone or that their vessels may be lost.

In the case of the "CAPITAINE TORRES", the vessel believed that the main engine would be restarted and would run satisfactorily and, therefore, did not declare a Mayday until some 5½ hours after the initial stoppage and loss of deck cargo, by which time the vessel's condition had considerably deteriorated.

The initial message to Sydney Coast Guard Radio and its subsequent transmission to the Rescue Co-ordination Centre at Halifax alerted Coast Guard personnel to the probability that a Mayday signal was imminent despite the vessel's assurance that it was not at that time necessary, with a consequence that the SAR initiative was undertaken at a time 5½ hours earlier than it might otherwise have been.

It would appear that, as in this case, SAR initiatives must sometimes rest with the judgement of SAR personnel who are experienced in various ship characteristics, the geographical location, the SAR capability and the local weather patterns and phenomena rather than await specific requests from vessels.

23. Search and Rescue (SAR) response

At 1936, Thursday, December 7, the CCG Radio (VCO) at Sydney, Nova Scotia, received the initial call from the "CAPITAINE TORRES" stating that some deck cargo had been lost overboard, the ship was listing to port, some containers on deck had shifted and the vessel was experiencing engine problems which would require her to be stopped for about 3 hours. Because the vessel had not declared a Mayday and, therefore, immediate

assistance was not apparently required, VCO advised the Rescue Co-ordination Centre (RCC) at Halifax, Nova Scotia, by telex, rather than the faster SARCOM (Telephone) link. However, the situation was assessed by RCC and it was decided that, despite the lack of a Mayday signal it would be prudent to initiate a Search and Rescue effort.

Four minutes later at 1940, number 413 Squadron, stationed at the Canadian Forces Base at Summerside, Prince Edward Island, received a tasking to provide a Buffalo aircraft and at 1957 the CCG vessel "SIR WILFRED GRENFELL", which was on standby at Port aux Basques, Newfoundland, was also tasked.

The "SIR WILFRED GRENFELL" was secured at her berth and, because of an industrial dispute, the ship's crew had been lodged in an hotel; however, despite this and the weather conditions, she was able to depart for the scene 45 minutes later at 2042. While enroute her speed became reduced to some 7.0 knots by the heavy seas which caused her bows to submerge in every third or fourth wave while freezing sea-spray covered the hull and superstructure.

The standby crew of the Buffalo aircraft prepared for the mission despite the weather which was of considerable concern, with towering cumulus clouds, turbulence, icing, low ceilings, poor visibility and high winds. The aircraft was already loaded with a SKAD (Sea Kit Air Droppable - 10 person liferaft and survival gear) and a pump. It was decided to load an extra SKAD and pump. The Buffalo was airborne and departed for the scene at 2200 and while enroute information was received from the "JOHANNA B" advising that she was also in difficulty.

The aircraft flew in and out of clouds and snow showers in winds of approximately 70 knots and visibility of only .25 to .50 mile. Homing in on the "CAPITAINE TORRES" by radar and radio direction finder, the Buffalo arrived over the vessel at 2303. For the next 15 minutes, the aircraft flew on a 500 foot visual flight observation pattern, passing over the ship three times. Onboard floodlights illuminated the vessel and she was seen to be listing heavily to port with her bow into the wind while waves were breaking over her decks; however, the condition and stow of the deck cargo could not be ascertained from the aircraft nor was it possible to take photographs. The vessel indicated by radiotelephone that she was stable and there was no intent to abandon at that time. The Buffalo, which was also in contact with the "SIR WILFRED GRENFELL", indicated to the "CAPITAINE TORRES" that the SAR vessel was 50 miles to the eastward and making an estimated

7 knots. At 2310, the Buffalo was retasked by RCC Halifax to assist the "JOHANNA B".

Aboard the aircraft the crew members were growing fatigued from the buffeting they had received since take off. Salt spray coated much of the plane and the pilots' windows became severely coated, restricting forward visibility. The airplane was shaking to the point where instruments were blurred to the sight. All of the crew were sick and, as the search continued, ice build-up on the aircraft's pitot system caused false readings on its airspeed indicators. Despite this, the aircraft dropped parachute flares from 1,000 feet in an attempt to sight any survivors from the "JOHANNA B". The flares were launched by a rescue technician, secured to the aircraft with a tethered line, who stood at the back of the aircraft's lowered ramp while throwing out the flares. After 45 minutes of unsuccessful searching, it was decided to return to the base at Summerside. However, in response to a call from a commercial vessel, which was passing through the area and had been tasked to assist, the aircraft returned and proceeded, from 4,500 feet, to provide flare illumination during the ship's passage so that she could search for the vessel. Departing the scene at 0141, after some 4.5 flying hours, the Buffalo regained its base, landing with some difficulty.

Two other commercial cargo vessels in the area had also been tasked and were attempting to come to the aid of the "CAPITAINE TORRES". The "KHUOZHNIK SARYAN" and the "GLOBAL STAR" were some 35 miles away and were heading towards the scene. Both ships were having difficulty in the prevailing conditions and were concerned for their own safety, therefore, both were advised to break off the attempt.

Aboard the "SIR WILFRED GRENFELL", icing had increased as the ship encountered colder air. When within VHF radiotelephone range, the "SIR WILFRED GRENFELL" kept in continuous contact with the "CAPITAINE TORRES" and by 0326 was only 2 miles away when the "CAPITAINE TORRES" advised of abandoning. Approximately 6 minutes later, the "SIR WILFRED GRENFELL" was on scene and commenced the search for survivors.

An Aurora aircraft from 415 Squadron Greenwood, Nova Scotia, which was also tasked by RCC to assist, was airborne at 0310. The Aurora arrived at the scene at 0340 and established contact with the "SIR WILFRED GRENFELL". Due to the weather and visibility, the aircraft climbed above cloud and conducted a radar and Forward Looking Infrared search and also assisted the "SIR WILFRED GRENFELL" by dropping parachute flares. At 0715, when daylight had occurred, the Aurora descended below

cloud and commenced a visual search. Between 0800 and 0930, the two liferafts were recovered by the "SIR WILFRED GRENFELL".

Six aircraft, comprising two Trackers and a charter Beech King Air, continued to search the area throughout Friday and Saturday, with no further sightings.

Although it had appeared that rescue by helicopter would probably be impossible, RCC Halifax had tasked 413 Squadron Labrador helicopter at 1930, Thursday. Liaison between the Labrador captain, the on-scene Buffalo crew, the Summerside weather office and the Air Controller at RCC was on-going throughout the course of the evening and it was agreed by all that the weather conditions made night helicopter operations impossible.

On Friday morning, after starting up in the protection of its hanger, the Labrador launched from Summerside in an attempt to reach a position closer to the scene in order to stand by in case survivors were sighted. Sixty knot winds were encountered soon after takeoff and after 70 minutes the Labrador had travelled only 23 miles from base. As a result, it was decided to return to Summerside and await better operating conditions.

On Friday afternoon, the Labrador was again able to become airborne. However, conditions again prevented it from contributing to the search.

The recovery of survivors directly from the "CAPITAINE TORRES", under the prevalent weather conditions and had she remained afloat, would have been a most difficult task for the SAR resources to accomplish.

24. Crew, formal marine qualifications and experience

Master	
Country of Birth	France
Date of Birth	01.07.49
Certificate	Capitaine de 1 ^{ère} classe de la navigation maritime (C1NM) (Combined Master/ Chief Engineer, all vessels in all areas)
Country and Date of Issue	France, Sept. 6, 1979

1st Mate
Country of Birth Madagascar
Date of Birth 09.11.54
Certificate Capitaine au petit cabotage
d'outre mer (Master overseas
coastal trade)
Country and Date of Issue New Caledonia, Dec. 28, 1983

2nd Mate
Country of Birth Fiji
Date of Birth 02.05.61
Certificate 2nd Mate Pacific Island
Country and Date of Issue Fiji, July 18, 1988

3rd Mate
Country of Birth Fiji
Date of Birth 24.06.54
Certificate 2nd Mate Pacific Island
Country and Date of Issue Fiji, Dec. 7, 1986

Radio Officer
Country of Birth Philippines
Date of Birth 05.09.39
Certificate Radio First Class
Philippines
Country and Date of Issue Philippines, Sept. 30, 1987

Chief Engineer
Country of Birth Holland
Date of Birth 03.06.55
Certificate Chief engineer "B" certificate
valid for cargo ships of not more
than 5890 Kw
Country and Date of Issue Holland, March 23, 1980

2nd Engineer
Country of Birth Tuvalu
Date of Birth 09.09.50
Certificate OM2, New Zealand
Country and Date of Issue Fiji, Feb. 19, 1987

3rd Engineer
Country of Birth Fiji
Date of Birth 03.11.60
Certificate OM2, Fiji
Country and Date of Issue Fiji, Aug. 5, 1987

4th Engineer	
Country of Birth	Fiji
Date of Birth	17.01.51
Certificate	Uncertificated

The vessel's Vanuatuan certificate of registry was issued provisionally upon Vanuatu receiving all of the required documents. It is not unusual for one country to accept the professional marine qualifications of another; provided officers are certificated by their own country, the equivalence of their certificates will be accepted by the Vanuatuan Authorities and the master and officers held the appropriate certificates as issued by their country of origin.

The other crew members held no formal marine qualifications.

The master, 1st mate and chief engineer had considerable experience as seafarers as did many others in the crew, however, none had experience of winter conditions in Eastern Canadian waters.

It is not known whether any members of the crew had attended specific Marine Emergency Duties courses of instruction which included the use of inflatable liferafts in extreme weather conditions, other than the instruction included in their formal marine qualifications.

25. Ship's open lifeboats/liferafts

Open lifeboats such as the two carried by the "CAPITAINE TORRES" do not give the occupants protection from the effects of weather; in extreme weather conditions they will invariably become swamped, even though remaining afloat due to their inherent buoyancy systems. The boats are carried one on each side of a vessel; therefore, when a vessel is listed to an angle of more than 15°, then only the boat on the side to which the vessel is listed can be safely launched. In addition and particularly during rough weather, the boat can be expected to be subject to damage during launching.

Inflatable liferafts are carried in the uninflated condition while contained in canisters which can be physically transported to an appropriate part of the vessel prior to launching and inflation. The "CAPITAINE TORRES" carried two such liferafts stowed one on either side of the accommodation deck below the navigation bridge; although it is not known from which side both were launched, it is considered that the one on the starboard side could have been transported to the port side where both could have been launched on the side to which

the vessel was listing and while in the lee of the vessel's hull and superstructure.

During the launching procedure, the rope painter which secures the raft to the vessel activates the inflation system which, in this case, consisted of compressed CO₂ gas; after the few seconds required for inflation the rafts become units which are complete with a protective canopy having entrances capable of being closed to the wind and weather.

It follows that the method of abandoning via the liferafts rather than the lifeboats could be considered to have been the most appropriate under the circumstances affecting the "CAPITAINE TORRES". However, once launched and inflated, considerable speed and agility would be required by the crew to board and release or cut the painter before the rafts became damaged. Such a situation requires adequate previous knowledge, instruction and practice.

26. Inflatable liferafts

Inflatable liferafts differ in shape and construction according to their manufacturer and also according to the size of the raft; however, they must meet the standards of construction and be provided with equipment as required by the International Maritime Organization (IMO), Safety of Life at Sea Conventions (SOLAS), in force at the time of manufacture. They are also required to meet the standards required by the vessel's flag state.

Vanuatu and the previous registries had ratified the SOLAS Convention and the liferafts had been provided to the vessel when she was built in 1978, being manufactured to the SOLAS standards which were in effect at that time. They had undergone annual inspection and servicing until October 1989.

The type of rafts carried by the "CAPITAINE TORRES" (see diagram and photographs in Annex) are both of 16 person capacity; each is octagonal in shape and the perimeter walls consist of two independently inflated buoyancy chambers joined one above the other. The conical shaped canopy roof and the floor are double skinned allowing them to be air inflated to provide insulation from cold or heat. The two entrances on each raft are provided with covers which are secured at their bottoms to the upper buoyancy chamber and can be closed from inside by draw ropes which pull the covers upwards.

The floor area is some 6.1 m² (square metres) and reportedly can safely carry up to twice the designated number of persons.

A survival pack is contained within the raft which, among many other items, holds a spare drogue, signalling lamp, distress rockets and flares.

There was no radio or radar reflector in the raft's equipment nor are they required by the SOLAS convention.

27. Liferafts, survivability and storm capabilities

The stability of an inflatable liferaft in rough seas is mainly dependent on its water ballast pockets preventing it from being overturned while at the crests of waves and subject to maximum wind velocity; further stability is provided by sea anchors (drogues) which also reduce the raft's rate of drift away from the scene.

It is not absolutely known whether the rafts from the "CAPITAINE TORRES" had remained in the upright position during the time elapsed from launching to retrieval. However, although both had lost the sea anchors which automatically deploy on launching, both rafts were upright when sighted and retrieved, which indicates that they may have remained upright, as once such rafts become overturned their canopies become immersed in the sea which generally prevents self-righting.

It is of paramount importance that the accesses to liferafts are securely closed in rough and cold weather to ensure protection to the occupants from exposure and to prevent damage to the canopy's inflatable supports. Such action requires a prior knowledge by the occupants of a raft's capabilities and the possible intentions of rescuers in order to overcome the discomforts experienced while inside the raft in extreme weather conditions. Such knowledge can only be acquired through previous experience or a comprehensive and thorough training programme.

The survivability of liferafts in storm conditions has been a matter of concern to the international maritime community for many years and this concern resulted in research which led to the upgrading of standards for the construction and performance of liferafts. The standards were included in an amendment to the 1974 Safety of Life at Sea (SOLAS) Convention which came into force in July 1986. The amendments included requirements for larger ballast pockets and stronger sea anchors of improved design with stronger attachments and lines.

The improvements have given liferafts manufactured since 1986 considerably more stability in storm conditions than those manufactured before that time, however, there was no provision

made to retrofit and improve existing rafts; nor was there provision to phase out the other rafts taking into account any deterioration in material due to aging.

Both of the "CAPITAINE TORRES" liferafts had been manufactured in 1977 and had undergone annual servicing as required by the SOLAS Convention of 1974, their last service being carried out by the manufacturers' authorized representative at Emden on October 6, 1989, when they were certificated as having retained the required standards.

28. The vessel's liferafts, inspection, repair and tests

Considerable damage was occasioned to both rafts during the recovery process; however, after recovery, the rafts were transported to the Canadian Department of National Defence Dockyard at Halifax, Nova Scotia, where they were subjected to inspection, repair and testing in order to determine as far as possible the degree to which they were capable of withstanding the weather and sea conditions prevailing at the time of the casualty, but above all to determine why no survivors or bodies were found in either raft.

At the time of retrieval from the sea, some 4 and 5 hours after the sinking, both rafts were seen to have their protective canopies collapsed into the bodies of the rafts and one to have its upper buoyancy chamber deflated. In the case of both rafts, the accesses to the interiors of their protective canopies were seen to be secured in the open position, the securing lashings being tied in a manner employed for stowage in their canisters, indicating that they had not been subsequently closed and re-opened.

Inspection and testing showed that both liferafts had inflated and the supporting arches for the canopies had also properly inflated.

The painters on both rafts were still attached to the rafts but both appeared to have broken and had not been cut to provide release from the vessel. In one case, 10 m of line was attached which was chafed over 5 m of its length from the free end. In the other case, 2 m remained which had been chafed and then broken at that point.

The sea anchors (drogues), on both rafts, had automatically deployed but had broken free, one at the position where its line had been attached to the raft, the other at a position along the length of its line some 2 m from the raft. The cause of breakage in both cases is considered to be due to the stresses imposed by the wind and sea.

The four stabilizing pockets situated under each raft were undamaged and had apparently served their purposes by keeping the rafts in the upright position.

The hand-operated air pumps in both rafts, which are for use in supplementing the CO2 inflation system, were in good working order but were still in their packaging and had not been used; significantly, for insulation purposes and to assist rigidity, the pumps would be necessary to inflate the floors, but the floors were not inflated. Subsequent tests showed that in the case of both rafts the canopy support arch-tubes showed no signs of damage and/or material deterioration causing loss of gas-tight integrity; the valves were in good order and both arch-tubes had been inflated by the CO2 system. Therefore, it seems that the collapse was due to the tubes being incapable of supporting the weight of the canopies while inflated by CO2 gas alone and as they became progressively water logged and/or ice covered the ambient air temperature reduced the expansion factor of the CO2 gas causing the arches to sag and to collapse.

The deflated buoyancy chamber on one of the rafts appeared to have been caused by the joining seams being ruptured, possibly due to an obstruction during launching.

In the case of both rafts, there was evidence of some deterioration to the fabric from which the canopies were constructed, but this did not affect the rafts' capabilities to properly inflate and to remain buoyant.

It could not be properly ascertained which raft was the one that broke free before being boarded and which was the one in which persons were initially sighted. There was no physical evidence that either raft had been occupied and the emergency packs had not been opened. However, it was apparent that neither raft could have sustained life under the prevalent weather conditions unless the access doorways had been securely closed in order to retain body heat, the floors and canopies inflated with air and the canopies further supported by the addition of air pumped into the support tubes.

29. Vessel Abandonments in Extreme Cold and Storm Conditions

The history of recoverability of crew, who were forced to abandon their commercial vessels in Canadian coastal/offshore waters on the East Coast of Canada during winter storms, is poor:

"GABRIELLA"	Oct. 1976	General Cargo Vessel	13 died
		699 Gross Tons	

"ARCTIC EXPLORER"	July 1981	Research Vessel 991 Gross Tons	13 died
"HUDSON TRANSPORT"	Dec. 1981	Product Tanker 4,076 Gross Tons	7 died
"OCEAN RANGER"	Feb. 1982	MODU (oil rig)	84 died
"MEKHANIK TARASOV"	Feb. 1982	Ro/Ro Vessel 4,262 Gross Tons	32 died
"JOHANNA B"	Dec. 1989	General Cargo 2,806 Gross Tons	16 died
"CAPITAINE "TORRES"	Dec. 1989	General Cargo 6,393 Gross Tons	23 died

The enormous problems of launching survival craft, embarking into them and staying dry and warm, by a crew already tired and emotionally drained, are overwhelming.

The Royal Commission into the loss of the MODU "OCEAN RANGER" examined this problem in depth. The report made a recommendation, No. 22, to the effect "that Canadian authorities consider the development of an evacuation system to provide an adequate and safe means of escape in storm conditions".

Considerable progress has been made internationally to develop free fall enclosed lifeboats, but the fitting of such craft is not a requirement of SOLAS.

Findings

The Vanuatuan registered cargo vessel "CAPITAINE TORRES" sank in Canadian waters while disabled in storm conditions in the Gulf of St. Lawrence during the early hours of December 8, 1989, with the loss of her full complement of 23 persons.

It would appear that the contributing factors to the sinking were as follows:

- propulsion problems were experienced with the main engine from a cause(s) which is/are not precisely known;
- having lost full or partial power the vessel could not be manoeuvred or hove to to afford the best protection to herself in the storm;

- becoming vulnerable and rolling and pitching in the storm conditions, the lashings on the deck cargo failed causing some to go overboard, and cargo to shift;
- the loss and shift of cargo caused the vessel to list and also damaged deck fittings and hatches;
- the vessel's list caused problems in re-starting the main engine and in keeping essential auxiliary machinery running; and
- seawater downflooded into the holds by way of damaged deck fittings and hatches; increased the list and reduced reserve buoyancy until the vessel sank.

It would appear that the factors contributing to the unsuccessful abandonment of the vessel and the subsequent loss of the crew were:

- in the storm conditions prevailing, the vessel was abandoned while in the final stages of sinking and while heavily listed;
- the boarding of a liferaft was delayed during which time it broke away from the vessel;
- the occupied liferaft was not utilized to its optimum survival capability;
- there was no means of communication with the liferaft to provide guidance to the occupants regarding survival and rescue;
- in the prevailing conditions the liferaft was not radar-detectable by the SAR vessel; and
- exposure, cold, and inexperience contributed to the unsuccessful outcome of the use of the lifesaving appliances.

Other Findings

The vessel delayed transmitting a MAYDAY but SAR had independently taken prior action to provide assistance.

Due to the storm conditions the tasked SAR vessel was unable to arrive on scene in time to effect a rescue attempt and for the same reason commercial vessels in the area were also unable to assist.

The same storm conditions precluded SAR helicopters from operating in the area despite attempts to do so.

The vessel's liferafts were manufactured prior to 1986 and as such were not required to meet standards introduced after the 1986 SOLAS Convention.

The sea anchor painters for both rafts had parted.

There were no survival suits carried on board, however none were required by regulation.

The lifejacket recovered from the sea indicates that its wearer did not manage to abandon the vessel before she sank.

The history of survival of persons abandoning vessels in Canadian winter storm conditions by conventionally launched liferafts and lifeboats is poor.

The recent history of engineering problems on this 11 year old vessel indicate that she was in need of mechanical overhaul.

Mechanical spare parts and repairs, together with additional engineering expertise and Classification Society inspections/surveys, could have been provided before departure from United States/Canadian ports.

The securing of deck cargo was undertaken by the vessel's crew without the benefit of assistance and guidance from cargo surveyors and/or stevedores.

The vessel's large GM would have caused a violent rolling motion when in the sea conditions prevailing at the time.

While the Vessel Traffic Reporting Systems for the coastal and offshore waters of Canada require comprehensive information on the condition of an in-bound vessel's hull and equipment, equally pertinent information on the certification of the crew is not required.

TRANSPORTATION SAFETY BOARD OF CANADA
INVESTIGATIONS MARINE
P.O. BOX 9120
ALTA VISTA TERMINAL
OTTAWA, ONTARIO
K1G 3T8

FEBRUARY 1991



Terms and Abbreviations

Bilges	Lower internal parts of hull designed to collect the drainage of water.
CCG	Canadian Coast Guard.
CCGS	Canadian Coast Guard Ship.
CFB	Canadian Forces Base.
CO ₂	Carbon-dioxide gas.
Containers	Standard rectangular boxes in which cargo is stowed and moved.
Deck-head	The inner bottom surface of a deck as seen from below; i. e.; the ceiling ashore.
Dunnage	Material used for the protection of stowed cargo.
ECAREG	Eastern Canada Traffic Regulation Zone.
ETA	Estimated time of arrival.
FW	Fresh water.
GM	Metacentric height.
GZ	Righting lever.
Hatch Coamings	The raised borders about the edges of hatches.
Heaving	Vertical bodily movement.
IMO	International Maritime Organization.
Mayday	Distress requiring immediate assistance.
MED	Marine emergency duties (course).
Pan	A situation that could lead to a distress.
Pitching	Movement about the transverse axis.
PPI	Plan position indicator (radar screen).
RCC	Rescue Coordination Centre.
Rolling	Movement about the longitudinal axis.

SAR	Search and Rescue.
Sea clutter	Radar echoes returned from the sloping sides of waves.
Securite	Navigation safety warning.
SKAD	Sea Kit Air droppable (lifteraft).
SOLAS	International Safety of Life at Sea Convention.
STCW	Training and Certification of Seafarers. (International Convention 1978)
Stevedores	Persons employed in the loading and unloading of cargo vessels.
Trim by head	The draught forward greater than the after draught.
Turnbuckles	Devices used to tighten lashings securing cargo.
'teen deck	A deck situated between the upper and lower decks.
USCT	United States Central Time.
USCG	United States Coast Guard.
VHF	Very high frequency (radio).

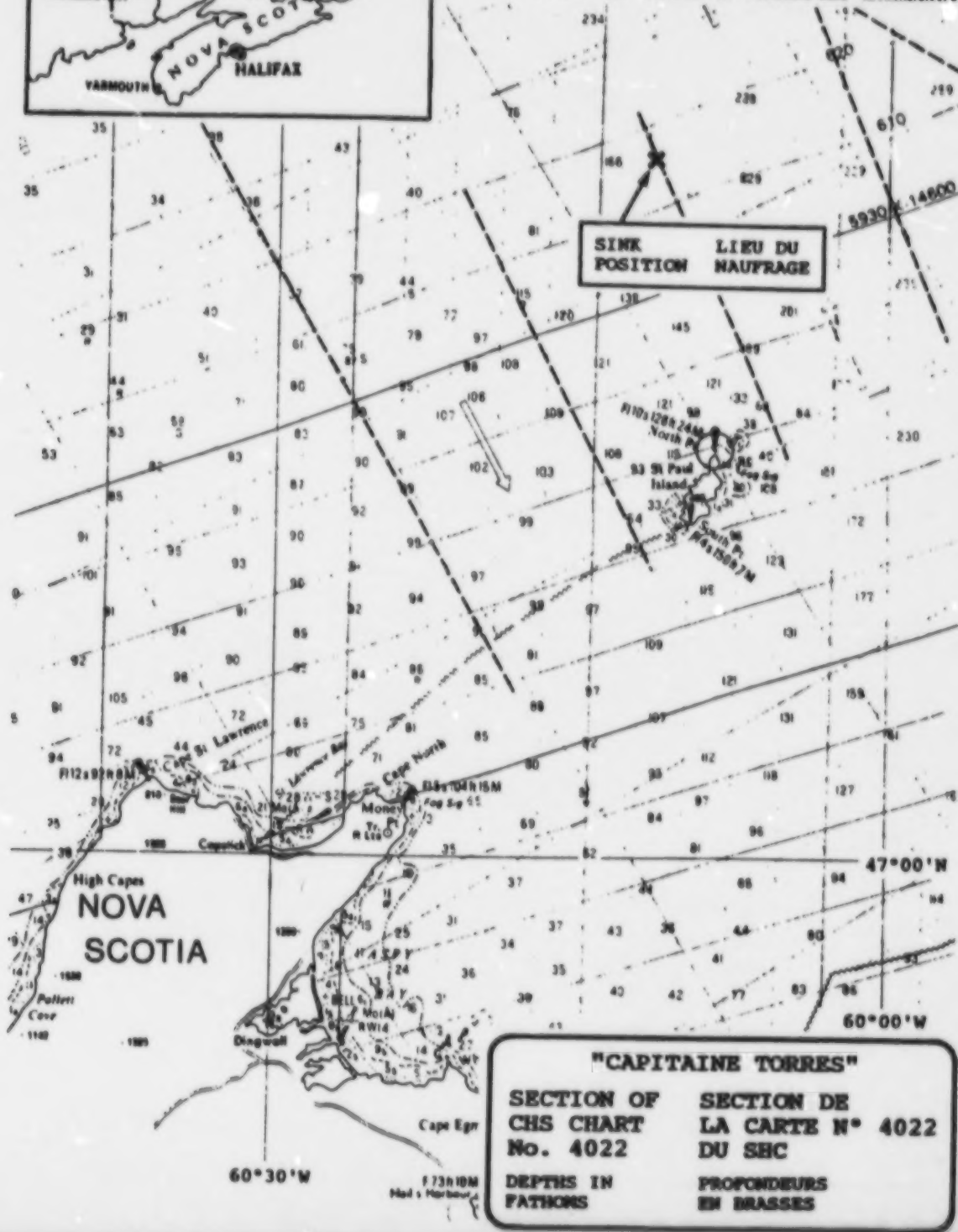


1. THE INFORMATION ON THIS CHART HAS BEEN COMPILED BY THE MARINE CASUALTY INVESTIGATIONS BRANCH

2. ALL TRACKS AND POSITIONS ARE APPROXIMATE

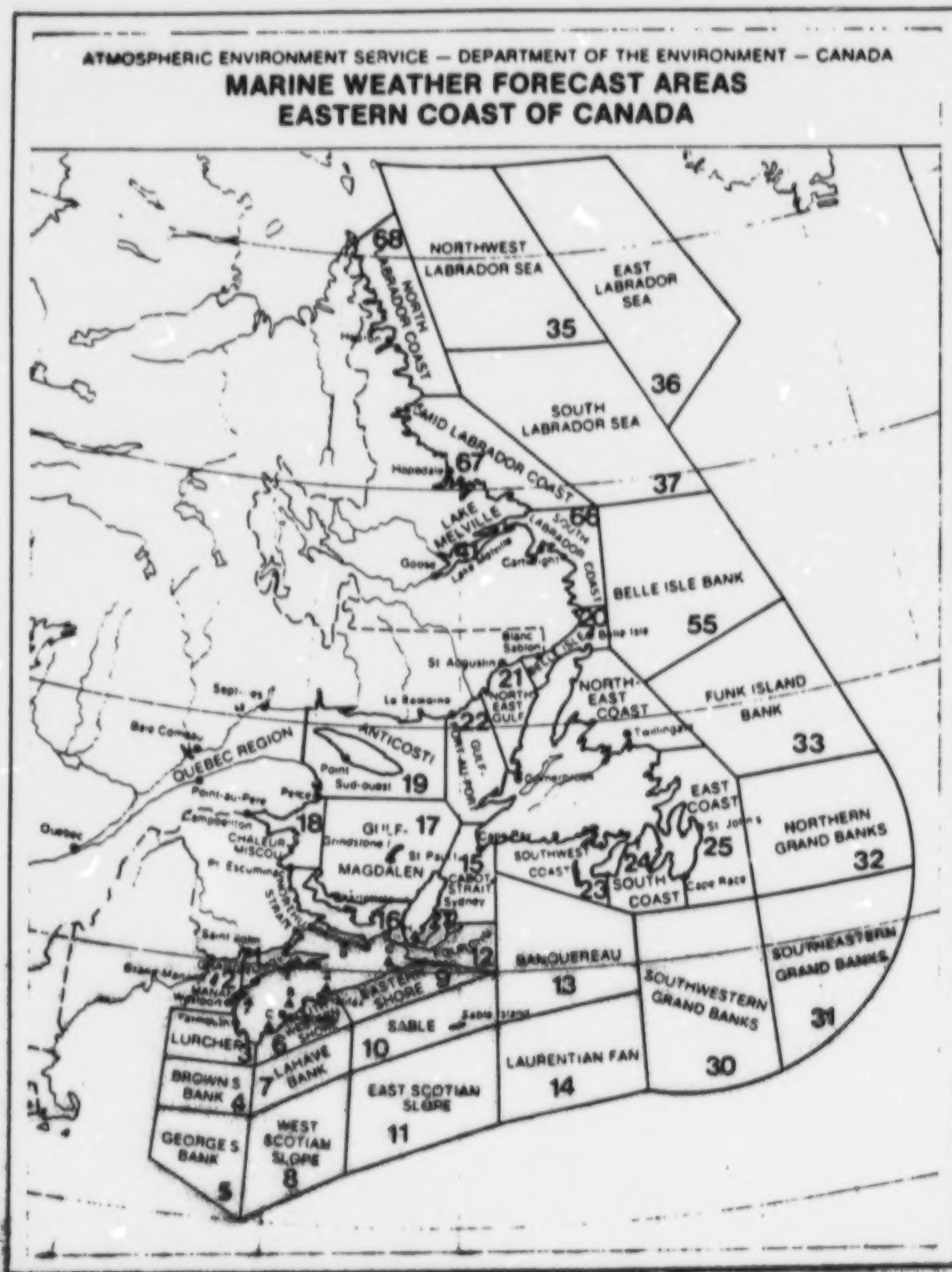
1. LA DIRECTION DES ENQUÊTES SUR LES ACCIDENTS MARITIMES A COMPIÉ LES RENSEIGNEMENTS SUR CETTE CARTE

2. TOUTS LES SILLAGES ET POSITIONS SONT APPROXIMATIFS



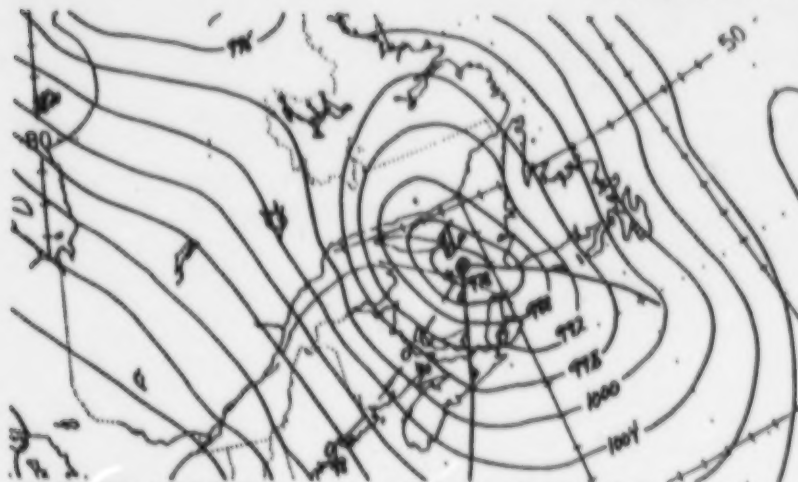
ANNEX I

NOTE: The area in which the casualty occurred is No. 15.



ANNEX I a

APPENDICE I a



DECEMBER 7, 14:00

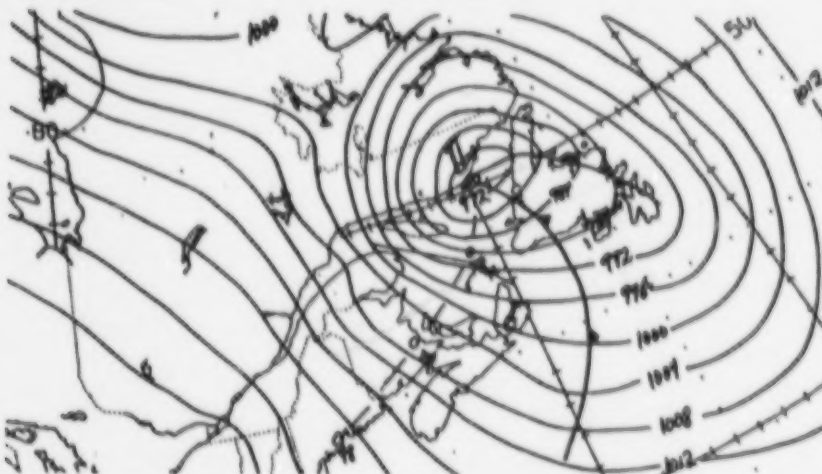
7 DÉCEMBRE 14:00

INDICATES POSITION
OF THE LOW

INDIQUE LA POSITION
DE LA BASSE PRESSION

INDICATES POSITION
OF THE VESSEL

INDIQUE LA POSITION
DU NAVIRE

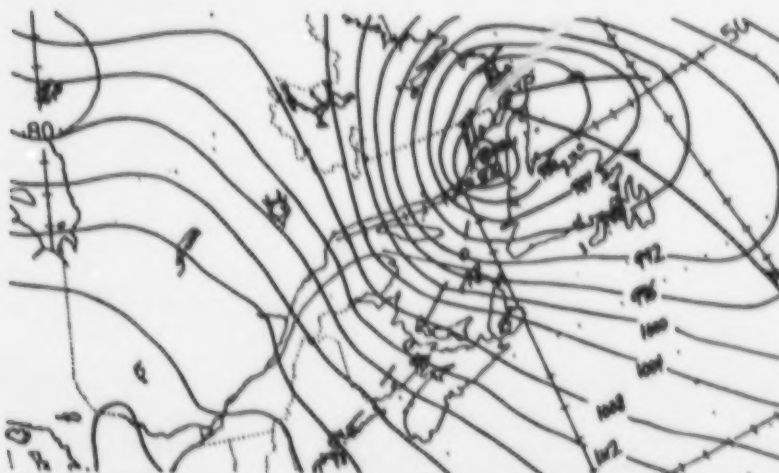


DECEMBER 7, 20:00

7 DÉCEMBRE 20:00

THE VESSEL HAD
BEEN STOPPED FOR
SOME 30 MINUTES

LE NAVIRE A ÉTÉ
ARRÊTÉ POUR
QUELQUES 30 MINUTES



DECEMBER 8, 02:00

8 DÉCEMBRE 02:00

THE VESSEL SANK
SOME 87 MINUTES
LATER

LE NAVIRE A SONDÉ
QUELQUES 87 MINUTES
PLUS TARD

CHAPTER 1415

CANADA SHIPPING ACT

Charts and Publications Regulations

REGULATIONS REQUIRING SHIPS TO HAVE ON BOARD, MAINTAIN AND USE APPROPRIATE CHARTS, TIDE TABLES, LISTS OF LIGHTS AND OTHER NAUTICAL PUBLICATIONS

Short Title

1. These Regulations may be cited as the *Charts and Publications Regulations*.

Interpretation

2. In these Regulations,
 "chart" means a nautical chart;
 "Information Bulletin", in respect of an area to be navigated by a ship, means the chart catalogue for that area published by the Canadian Hydrographic Service;
 "national authority" means the government of a country;
 "ship" includes every description of vessel used in navigation and not propelled by oars.

PART I

SHIPS IN CANADIAN WATERS AND FISHING ZONES

Application

3. (1) Subject to subsection (2), this Part applies to all self-propelled ships, other than ships of war, in
 (a) Canadian waters south of the 60th parallel of north latitude;
 (b) Canadian waters north of the 60th parallel of north latitude that are not within a shipping safety control zone prescribed pursuant to the *Arctic Waters Pollution Prevention Act*; and
 (c) a fishing zone of Canada prescribed pursuant to the *Territorial Sea and Fishing Zones Act*.

Carriage of Charts and Publications

4. (1) Every ship shall have on board, in respect of each area to be navigated by the ship, at least the latest editions of the charts and the most recent issues of the publications that the ship is required by sections 5 and 6 to use.

(2) When making a voyage described in Column I of an item of the schedule, every ship shall, in addition to the charts required by subsection (1), have on board

- (a) the latest editions of the Canadian Hydrographic Service charts described in Column II of that item; or
 (b) the latest editions of the charts published by any national authority that

- (i) cover the same area as,
 (ii) are at least as complete, accurate, intelligible and up-to-date as, and

CHAPITRE 1415

LOI SUR LA MARINE MARCHANDE DU CANADA

Règlement sur les cartes et publications

RÈGLEMENT PRESCRIVANT AUX NAVIRES D'AVOIR À BORD, DE METTRE À JOUR ET D'UTILISER LES CARTES, L'ANNUAIRE DES MARÉES, LES NOMENCLATURES DES FEUX ET LES AUTRES PUBLICATIONS NAUTIQUES

Titre abrégé

1. Le présent règlement peut être cité sous le titre: *Règlement sur les cartes et publications*.

Interprétation

2. Dans le présent règlement,
 «administration nationale» désigne le gouvernement d'un pays;
 «Bulletin d'information», en ce qui concerne une région où un navire est appelé à naviguer, désigne le catalogue des cartes que publie le Service hydrographique du Canada pour cette région;
 «carte» désigne une carte marine;
 «navire» comprend les bâtiments de toute sorte employés à la navigation et non mus par des rames.

PARTIE I

NAVIRES DANS LES EAUX CANADIENNES ET LES ZONES DE PÊCHE DU CANADA

Application

3. (1) Sous réserve du paragraphe (2), la présente partie s'applique à tous les navires autopropulsés, sauf les navires de guerre, qui naviguent
 a) dans les eaux canadiennes au sud du 60^e parallèle de latitude nord;
 b) dans les eaux canadiennes au nord du 60^e parallèle de latitude nord, qui ne sont pas dans les limites d'une zone de contrôle de la sécurité de la navigation établie en vertu de la *Loi sur la prévention de la pollution des eaux arctiques*; et
 c) dans une zone de pêche du Canada établie en vertu de la *Loi sur la mer territoriale et les zones de pêche*.

Cartes et publications

4. (1) Tout navire doit avoir à bord, pour chaque région où il est appelé à naviguer, au moins les cartes et publications les plus récentes qu'il est tenu d'utiliser selon les prescriptions des articles 5 et 6.

(2) Tout navire qui fait un voyage décrit à l'un des articles du tableau de l'annexe, dans la colonne I, doit avoir à bord, en plus des cartes prescrites par le paragraphe (1),

- a) les cartes les plus récentes du Service hydrographique du Canada décrites dans la colonne II de cet article; ou
 b) les cartes les plus récentes publiées par une administration nationale

- (i) qui représentent la même région,
 (ii) qui sont au moins aussi détaillées, précises, intelligibles et récentes, et

ANNEX II

(iii) are at a scale that is at least 75 per cent of the scale of the latest editions of the charts described in Column II of that item.

Use of Charts

5. (1) Subject to subsection (2), every ship shall, in respect of the immediate area in which the ship is located, make proper navigational use of a chart that

- (a) is published by a national authority;
- (b) covers that immediate area; and
- (c) provides a representation of the area covered by the chart that is

(i) as complete, accurate, intelligible and up-to-date as, and

(ii) at a scale that is at least 75 per cent of the scale of the largest scale chart described in the most recent issue of the *Information Bulletin* that is a chart of that immediate area.

(2) Where a ship is located

(a) more than 5 nautical miles from any charted feature or charted depth of water that represents a potential hazard to the ship, or

(b) within the area covered by a chart described in the most recent issue of the *Information Bulletin* as a chart

(i) primarily intended for use of pleasure craft, or

(ii) primarily of an anchorage, a river or a harbour that is not entered by the ship,

paragraph (1)(c) shall be deemed to refer to the second-largest scale chart of that immediate area as described in the most recent issue of the *Information Bulletin*, if that second-largest scale chart is at a scale of not less than 1:400,000 (5.486 nautical miles to the inch or 2.160 nautical miles to the centimetre).

Use of Other Publications

6. (1) Subject to subsections (2) and (3), every ship shall, in respect of each area to be navigated by the ship, make proper navigational use of

(a) the following Canadian Government publications:

(i) tide and current tables,

(ii) sailing directions,

(iii) *List of Lights, Buoys and Fog Signals*,

(iv) where the ship is fitted with radio equipment, *Radio Aids to Marine Navigation*,

(v) *Code of Navigation Practices and Procedures*, and

(vi) where the ship is making a voyage during which ice may be encountered, *Ice Navigation in Canadian Waters*;

(b) the *Information Bulletin*; and

(c) the annual edition of *Canadian Notices to Mariners*.

(2) A publication of any national authority may be substituted for any Canadian Government publication described in paragraph (1)(a), if the publication is, in respect of information that may affect the safe navigation of the ship in the area being navigated, as complete, accurate, intelligible and up-to-date as the Canadian Government publication.

APPENDICE II

(iii) dont l'échelle est au moins égale à 75 pour cent par rapport aux plus récentes cartes décrites dans la colonne II de cet article.

Utilisation des cartes

5. (1) Sous réserve du paragraphe (2), tout navire doit, pour la région même où il se trouve, utiliser correctement, lorsqu'il y navigue, une carte

(a) qui est publiée par une administration nationale;

(b) qui représente cette région; et

(c) qui donne de la région cartographiée une représentation

(i) aussi détaillée, précise, intelligible et récente que celle que donne, et

(ii) à une échelle au moins égale à 75 pour cent de l'échelle à laquelle a été établie

la carte à l'échelle la plus grande de la région, décrite dans la plus récente édition du *Bulletin d'information*.

(2) Lorsqu'un navire se trouve

(a) à plus de 5 milles marins d'un objet ou d'une sonde qui sont indiqués sur une carte et qui peuvent présenter un danger pour le navire, ou

(b) dans les eaux d'une région dont la carte, d'après la plus récente édition du *Bulletin d'information*, est une carte

(i) qui est surtout destinée aux bateaux de plaisance, ou

(ii) qui représente surtout un mouillage, un cours d'eau ou un port dans les eaux duquel ce navire ne pénètre pas,

l'alinéa (1)(c) est censé s'appliquer à la carte de ladite région, qui est décrite dans la plus récente édition du *Bulletin d'information* et dont l'échelle est la deuxième par ordre de grandeur décroissante; toutefois, cette échelle ne doit pas être plus petite que 1:400,000 (5.486 milles marins au pouce ou 2.160 milles marins au centimètre).

Utilisation d'autres publications

6. (1) Sous réserve des paragraphes (2) et (3), tout navire doit, pour chaque région dans laquelle il est appelé à naviguer, utiliser correctement, lorsqu'il y navigue,

(a) les publications suivantes du gouvernement canadien:

(i) l'annuaire des marées et des courants,

(ii) les instructions nautiques,

(iii) *Livre des feux, des bouées et des signaux de brume*,

(iv) si le navire est doté d'appareils radio, *Aides radio à la navigation*,

(v) le *Code des pratiques et méthodes de navigation*, et

(vi) si le navire fait un voyage au cours duquel il peut rencontrer des glaces, le *Guide à l'usage des navires marchands qui naviguent dans les glaces en eaux canadiennes*;

(b) le *Bulletin d'information*; et

(c) l'édition annuelle des *Avis aux marins*.

(2) Une publication de toute administration nationale peut remplacer une publication du gouvernement canadien mentionnée à l'alinéa (1)(a), si elle est aussi détaillée, précise, intelligible et récente que la publication du gouvernement canadien, pour ce qui est des renseignements qui peuvent concerner la sécurité de la navigation du navire dans la région où il est appelé à naviguer.

ANNEX II

(3) No ship need use the *List of Lights, Buoy and Fog Signals* if the information contained in that publication that may affect the safe navigation of the ship is described on the charts used by the ship.

Exception

8. Notwithstanding the provisions of this Part, a ship shall be deemed not to have contravened this Part if, before the ship navigated an area for which a chart or publication is required and after the ship was informed that it would be navigating that area, it was not possible for the ship

- (a) to obtain the required chart or publication at any harbour at which the ship called;
- (b) to obtain safely and legally the required chart or publication at any harbour that the ship passed at such a distance that it would not have been unreasonable for the ship to obtain the chart or publication at that harbour; or
- (c) to receive a radio navigation warning containing information that may have affected the safe navigation of the ship in that area.

APPENDICE II

(3) Il n'est pas nécessaire pour un navire d'utiliser le *Livre des feux, des bouées et des signaux de brume* si les renseignements qu'elle contient et qui peuvent concerner la sécurité de la navigation du navire sont donnés sur les cartes qu'utilise le navire.

Exception

8. Nonobstant les dispositions de la présente partie, un navire n'est pas censé les avoir enfreintes si, avant de naviguer dans une région pour laquelle il est requis d'avoir une carte ou une publication et après avoir été informé qu'il naviguerait dans cette région, il lui a été impossible

- a) d'obtenir la carte ou la publication requise à un port où il a fait escale;
- b) d'obtenir en toute sécurité et licitement la carte ou la publication requise à un port devant lequel il a passé à une distance qui lui permettait raisonnablement d'obtenir ladite carte ou publication à ce port; ou
- c) de recevoir un message radio sur les dangers pour la navigation contenant des renseignements qui pouvaient concerner la sécurité de la navigation du navire dans cette région.

ANNEX III



**1989
Annual Edition**

**NOTICES
TO
MARINERS
1 to 43**

ANNEX III

26 VESSEL TRAFFIC REPORTING SYSTEMS FOR THE COASTAL AND OFFSHORE WATERS OF CANADA

1 Introduction

1.1 The purpose of this notice is to describe to shipboard personnel the ship reporting procedures to be followed by vessels when:

- 1 within or intending to enter the waters of Eastern or Arctic Canada not contained within a local Vessel Traffic Services zone; and
- 2 intending to enter the waters of Western Canada

Note: When within the waters of the Western Canada Traffic Zone, ships shall follow procedures specified in Notice No. 25

1.2 These offshore VTS systems utilize the Canadian Coast Guard Radio Stations as the primary means of communication between ship and shore. Participation with the offshore VTS centres eliminates the need for ships to make certain reports more than once.

1.3 Ice information, ice routing and icebreaker assistance may be obtained through the Eastern Canada Traffic System (ECAREG CANADA) and the Arctic Canada Traffic System (NORDREG CANADA). Refer to Notice No. 6 of the Annual Edition, Notices to Mariners and the Publication "Ice Navigation in Canadian Waters."

2 Zone description

The coastal and offshore waters of Canada have been subdivided into three distinct zones, each with their own telegraphic identifier. These zones are as follows:

2.1 Eastern Canada

Eastern Canada Vessel Traffic Services Zone includes Canadian waters on the east coast of Canada and Fishing Zone 1 (Gulf of St. Lawrence) as prescribed by the *Fishing Zones of Canada* (Zones 1, 2 and 3) Order.

- (a) south of parallel of 60° north latitude; and
- (b) in the St. Lawrence River east of the meridian of 66° west longitude.

It excludes the waters of Ungava Bay and the waters within the Vessel Traffic Services Zones for Halifax Harbour and Approaches, the Bay of Fundy and Approaches, Port aux Basques Harbour and Approaches, Placentia Bay and Approaches, and St. John's Harbour and Approaches as defined in Notice No. 25 of the Annual Edition, Notices to Mariners.

Telegraphic Identifier - ECAREG CANADA

2.2 Arctic Canada

Arctic Canada Traffic Zone includes those waters of Ungava Bay, Hudson Bay and James Bay south of the parallel of 60° north latitude and the waters to which the Arctic Waters Pollution Prevention Act apply.

It excludes MacKenzie Bay and Kugmallit Bay south of the parallel of 70° north latitude and east of the meridian of 139° west longitude.

Telegraphic Identifier - NORDREG CANADA

2.3 Western Canada

Western Canada Traffic Zone includes all Canadian waters on the west coast of Canada as described in Schedules IX, X and XI of Notice No. 25.

Telegraphic Identifier - WESTREG CANADA

3 Application

3.1 ECAREG

With respect to the Eastern Canada VTS Zone, the *Eastern Canada Vessel Traffic Services Zone Regulations* apply to every ship of 500 tons, gross tonnage or more. Participation is mandatory.

3.2 NORDREG

With respect to the Arctic Canada Traffic Zone the provisions of this notice apply to every ship of 300 tons, gross tonnage, or more. Participation is voluntary, however, mariners are encouraged to participate fully to receive the maximum benefit.

3.3 WESTREG

With respect to the Western Canada Traffic Zone, the provisions of this notice apply to every ship of 500 tons, gross tonnage, or more. Participation is voluntary, however, mariners are encouraged to participate fully to receive the maximum benefit.

3.4 All zones

In addition, the provisions of this notice apply (on a mandatory or voluntary basis, as applicable) to all other ships meeting the following criteria:

- (a) every ship that is engaged in towing or pushing one or more vessels, where the combined tonnage of that ship and its tow amounts to 500 tons, gross tonnage, or more; and
- (b) every ship carrying a pollutant or dangerous goods, or engaged in towing or pushing a vessel carrying a pollutant or dangerous goods as prescribed in the:
 - (i) *Oil Pollution Prevention Regulations*,
 - (ii) *Pollutant Substances Regulations*,

ANNEX III

Dangerous Goods Shipping Regulations

International Maritime Dangerous Goods Code (IMDG) and Chemical Carriage (Steamships) Regulations

4 Responsibility

4.1 The master shall supply all information that is required of him by this notice and shall comply with every marine traffic direction.

4.2 Notwithstanding Section 4.1, the master, pilot or person in charge of the deck watch may take any action that may be required to ensure the safety of the ship or any other ship.

4.3 When the required communications cannot be conducted owing to radio difficulties, a ship may continue with its voyage and the master shall make the required communications as soon as possible.

5 Traffic clearance

5.1 A "traffic clearance" is an authorization for a ship to proceed subject to such conditions as may be included in the authorization. A traffic clearance does not eliminate the need for other authorizations required by legislation or by-laws.

5.2 A traffic clearance is required before:

- 1 entering a traffic zone (see 7.1, 8.1 or 9.1 as appropriate),
- 2 departing a berth (see 7.3 or 8.3 as appropriate), and
- 3 proceeding after being stranded, stopped due to breakdown of main propulsion machinery or steering gear, or involved in a collision (see 6.4.1).

5.3 A traffic clearance may be obtained by providing the appropriate report in accordance with procedures specified in the appropriate sections.

Exceptions to clearance requirements are contained in the appropriate reporting procedures.

6 Reports

6.1 General

All times given in reports required by this notice shall be Universal Time Coordinated (UTC).

A report shall use the appropriate telegraphic identifier and be communicated to the nearest Canadian Coast Guard Radio Station.

The master of a ship shall ensure that reports are made in accordance with the stated requirements.

6.2 Information required

The following information may be required in a report:

- (a) the name of the ship,
- (b) the radio call sign of the ship,
- (c) the name of the master of the ship,

- (d) the position of the ship,
- (e) the time the ship arrived at the position,
- (f) the course of the ship, if any,
- (g) the speed of the ship, if any,
- (h) the prevailing weather conditions (including ice, if applicable),
- (i) the estimated time that the ship will enter the Vessel Traffic Services Zone,
- (j) the estimated time the ship will depart the berth,
- (k) the destination of the ship,
- (l) the estimated time of arrival of the ship at the destination,
- (m) the route the ship intends to take through the Vessel Traffic Services Zone to arrive at the destination,
- (n) the name of the last port of call of the ship,
- (o) the draft of the ship,
- (p) what cargo, dangerous goods by class, or pollutant, if any, are carried on board the ship,
- (q) which of the charts or publications required to be carried on board the ship pursuant to the *Charts and Publications Regulations* are not on board the ship,
- (r) any defect in the ship's hull, main propulsion machinery, steering system, radars, compasses, radio equipment, anchors or cables,
- (s) any discharge, or threat of discharge, of a pollutant from the ship into the water, and any damage to the ship that may result in the discharge of a pollutant from the ship into the water,
- (t) the name of the Canadian or United States agent of the ship, and
- (u) the date of expiration of the Non-Canadian Ships Compliance Certificate, if any, issued to the ship pursuant to regulations made under section 730 of the *Canada Shipping Act*.

6.3 Routine reports

Procedures for providing routine reports are described in the appropriate zone procedures in sections 7, 8 and 9.

6.4 Non-routine reports

6.4.1 Stranding, Propulsion or Steering Failure, and Collision

When a ship is within the Eastern Canada VTS Zone or Arctic Canada Traffic Zone, a report is required immediately before a ship proceeds underway after being stranded, or having had a propulsion or steering gear failure, or having been involved in a collision. The following information shall be provided:

- (a) name of ship,
- (b) position of ship, and
- (c) description of the incident.

ANNEX III

6.4.2 Other occurrences

Any of the following conditions should be immediately reported when the ship is within or about to enter a zone.

Note: Ships within the Western Canada Traffic Zone should follow procedures as in Notice No. 25.

- (a) the occurrence on board the ship of any fire that is detrimental to safe navigation,
- (b) the involvement of the ship in a collision, grounding or striking that is detrimental to safe navigation,
- (c) any defect in the ship's hull, main propulsion machinery, steering system, radars, compasses, radio equipment, anchors or cables that is detrimental to safe navigation,
- (d) another ship in apparent difficulty,
- (e) any obstruction to navigation,
- (f) any aid to navigation that is functioning improperly, damaged, off-position or missing,
- (g) any ice and weather conditions that are detrimental to safe navigation, or
- (h) the presence of any pollutant in the water.

Items (e), (f) and (h) are not required if the information has been previously promulgated by a Notice to Shipping.

6.4.3 Change in information

A report shall be made whenever a significant change occurs in the information contained in any report made pursuant to this Notice, except in the case of reports 7.4 and 8.5.

7 ECAREG — Routine reports

Where the *Eastern Canada VTS Zone Regulations* require a particular procedure, the Commissioner may, on written request, permit any other procedure if he is satisfied that it is at least as satisfactory for the purposes of the Regulations as the required procedure.

7.1 Entering the zone

- 7.1.1 A report containing the information listed in 6.2, except item (j), shall be made 24 hours prior to entering the zone, or as soon as practical where the estimated time of arrival of the ship at the zone is less than 24 hours after the time the ship departed from the last port of call.

This report is not required in a case where the ship is on a voyage between two ports within the zone.

- 7.1.2 A report containing the information listed in 6.2(a), (b), (d), (h) and (i), shall be made immediately before the ship crosses the zone boundary when entering the zone.

This report is not required when entering directly from a local VTS zone.

7.2 Arriving at a berth

A report containing the information listed in 6.2(a) and (b), as well as the following information:

- (a) port of arrival, and
- (b) time of arrival,

shall be made on arrival of the ship at a berth.

7.3 Departing a berth

This report is not required where the ship is proceeding to another berth in the same port.

A report containing the information listed in 6.2, except item (i), shall be made two hours before a ship departs a berth.

A traffic clearance to depart a berth is valid for one hour from estimated time of departure. Where a traffic clearance to depart a berth has expired because of a revised time of departure, a new traffic clearance is required. In this case, the report need only contain the ship's name, callsign, position and revised time of departure.

7.4 Exiting the zone

A report containing the information listed in 6.2(a), (b), (d) and (h), shall be made immediately before the ship crosses the seaward boundary.

In a case where exiting a zone coincides with entering a local VTS zone, this report is not required. Procedures as per Notice No. 25 shall be followed.

8 NOADREG — Routine reports

8.1 Entering the zone

- 8.1.1 A report containing the information listed in 6.2, except item (j), but including the following information:

- (a) ice class (type or Arctic class category), if applicable, and Classification Society,
- (b) amount of oil on board (fuel and cargo), if such amount exceeds 453 m³ (15,988 ft³); and
- (c) date of issue of Arctic Pollution Prevention Certificate, if carried and name of Classification Society,

shall be made 24 hours prior to entering the zone, or as soon as practical where the estimated time of arrival of the ship at the zone is less than 24 hours after the time the ship departed from the last port of call.

This report is not required in a case where the ship is on a voyage between two ports within the zone.

- 8.1.2 A report containing the information listed in 6.2(a), (b), (d), (h) and (i), shall be made immediately before the ship crosses the zone boundary when entering the zone.

ANNEX III

8.2 Arriving at a berth

A report containing the information listed in 6.2(a) and (b), as well as the following information:

(a) port of arrival; and

(b) time of arrival,

shall be made on arrival of the ship at a berth.

8.3 Departing a berth

This report is not required where the ship is proceeding to another berth in the same port.

A report containing the information listed in 6.2, except item (i), and also containing the information in 8.1.1(a), (b) and (c) shall be made not more than two hours and not less than one hour before departing a berth.

A traffic clearance to depart a berth is valid for one hour from estimated time of departure. Where a traffic clearance to depart a berth has expired because of a revised time of departure, a new traffic clearance is required. In this case, the report need only contain the ship's name, callsign, position and revised time of departure.

8.4 1600 UTC report

A report containing the information listed in 6.2(a), (b), (d) and (h) shall be made daily at 1600 UTC.

8.5 Exiting the zone

A report containing the information listed in 6.2(a), (b), (d) and (h), shall be made immediately before the ship crosses the seaward boundary.

9 WESTREG - Routine report

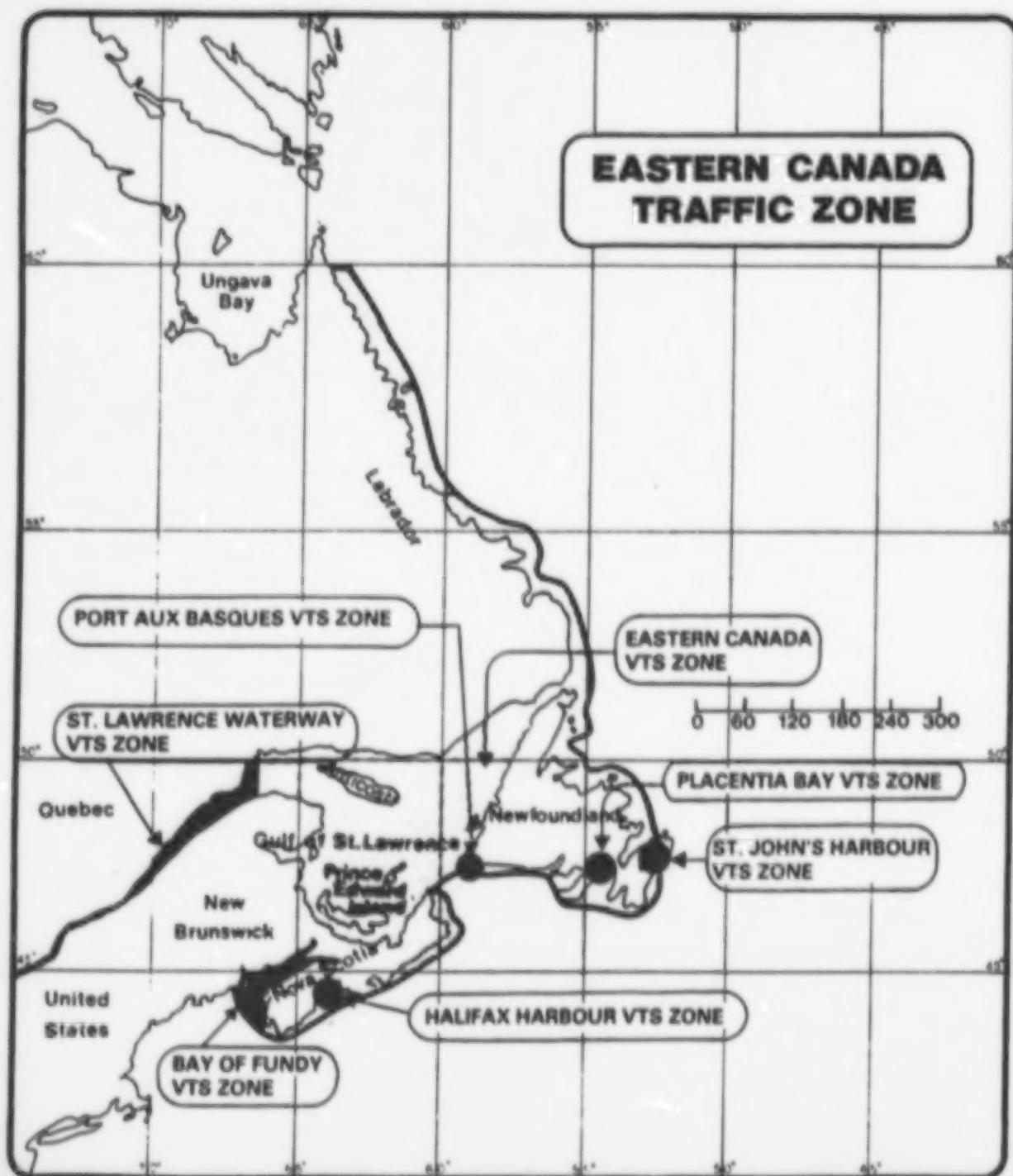
9.1 Entering the zone

A report containing the information listed in 6.2, except items (c) and (j), shall be made 24 hours prior to entering the zone, or as soon as practical where the estimated time of arrival of the ship at the zone is less than 24 hours after the time the ship departed from the last port of call.

This report is only required where the ship is entering the zone from seaward.

Authority: Canadian Coast Guard (AMAE)

ANNEX III a



WIND CHILL FACTOR

WIND CHILL FACTOR

Nearly everyone is aware of how much colder it feels outdoors on a windy day as compared to when there is no wind, particularly in the winter. This apparent 'coldness' is due to the more rapid cooling effect produced by the wind to make it feel colder than it really is. The combined effect of wind and low temperatures is experienced by most Canadians in just about every part of Canada. The effect can produce serious and often dangerous conditions.

Wind Chill Factor as described in this pamphlet is a measure of the combined chilling effect of wind and temperature. Although the actual calculation of the factor is based upon how fast water will cool with the combination of low temperature and wind, it has been found to be equally applicable to the cooling effect experienced by the human body and by an inanimate object.

The advantage of *Wind Chill Factor* over other measurements methods is that it represents a real rate of cooling, in other words how fast an object cools. For example, the combination of a specific temperature and wind speed can be related to how fast exposed flesh will freeze. On the average the value of 1625 watts per square meter represents the condition where exposed flesh will freeze. It also gives an indication of how difficult it is to maintain an object, for example a house, at a given temperature.

In the past it has been common practice to use an equivalent temperature (wind chill temperature) to relate wind and temperature. Unfortunately the values obtained by this method often have been beyond the experience of most people. For example, -50°C occurs in relatively unpopulated areas of Canada. More importantly the equivalent temperature still does not relate to the combined effect of wind and temperature on the human body. It also is too easily confused with the actual temperature.

EXAMPLES OF THE EFFECT OF WIND CHILL FACTOR

1. Water will freeze more quickly at high wind chill factors than at low.

2. The ability of an engine block heater to keep a car engine warm decreases with increasing wind chill factor.

3. The length of time a car can be left turned off before reaching the surrounding air temperature decreases with increasing wind chill factor.

4. With increasing wind chill factor there is an increase in the fuel needed to heat buildings, particularly when the building is poorly insulated.

5. Exposed flesh freezes more rapidly with higher wind chill factors.

EXAMPLES OF WIND CHILL FACTOR

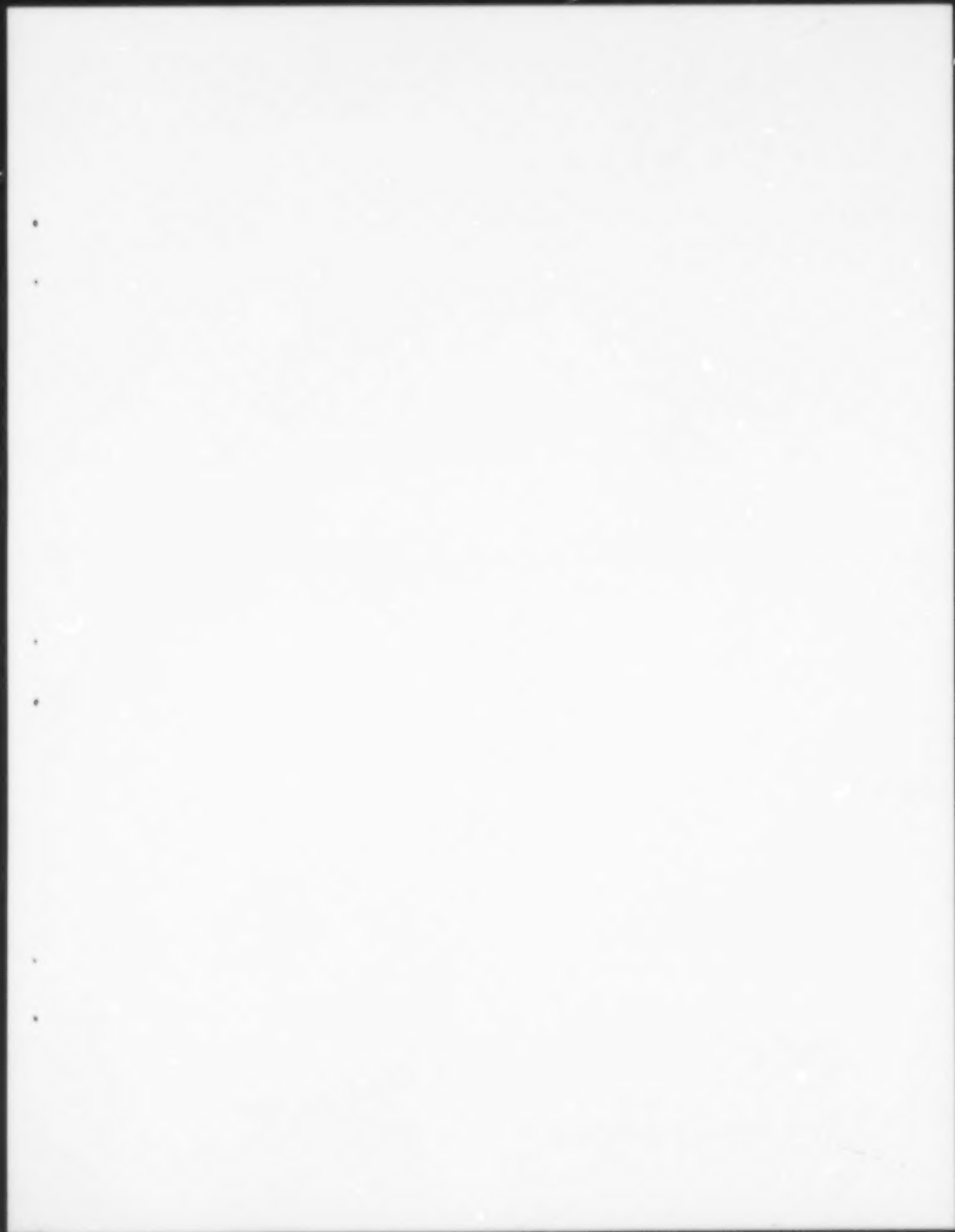
Wind Chill Factor	Comments
700	Conditions considered comfortable when dressed for skiing.
1200	Conditions no longer pleasant for outdoor activities on overcast days.
1400	Conditions no longer pleasant for outdoor activities on sunny days.
1600	Freezing of exposed skin begins for most people depending on the degree of activity and the amount of sunshine.
2300	Conditions for outdoor travel such as walking become dangerous. Exposed areas of the face freeze in less than 1 minute for the average person.
2700	Exposed flesh will freeze within half a minute for the average person.

The units of *Wind Chill Factor* used in this pamphlet are watts per square meter.

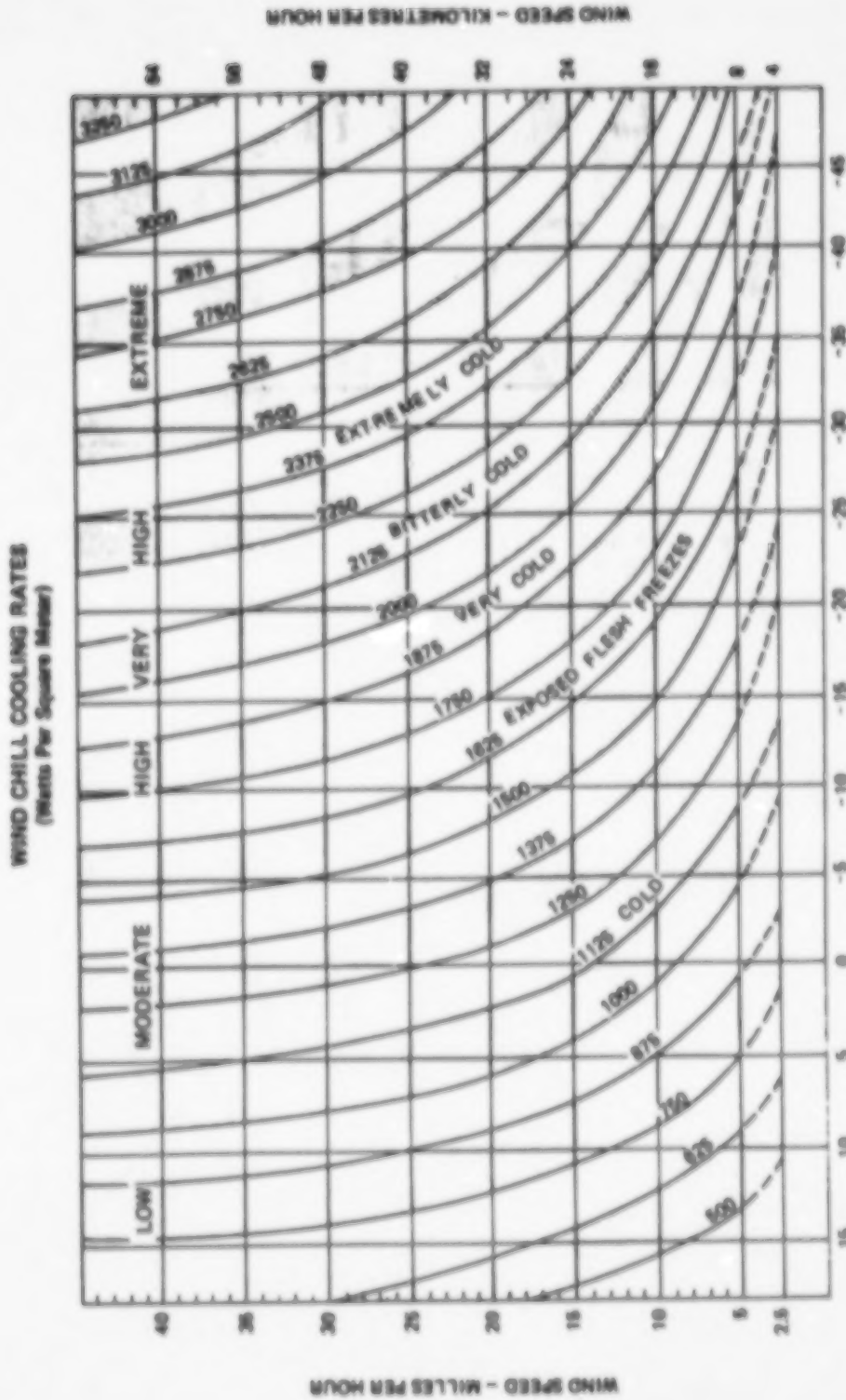
ACKNOWLEDGEMENT:

Saskatchewan Research Council has assisted in providing information contained in this pamphlet.

Refer to diagram on opposite page for graph to calculate *Wind Chill Factor*.



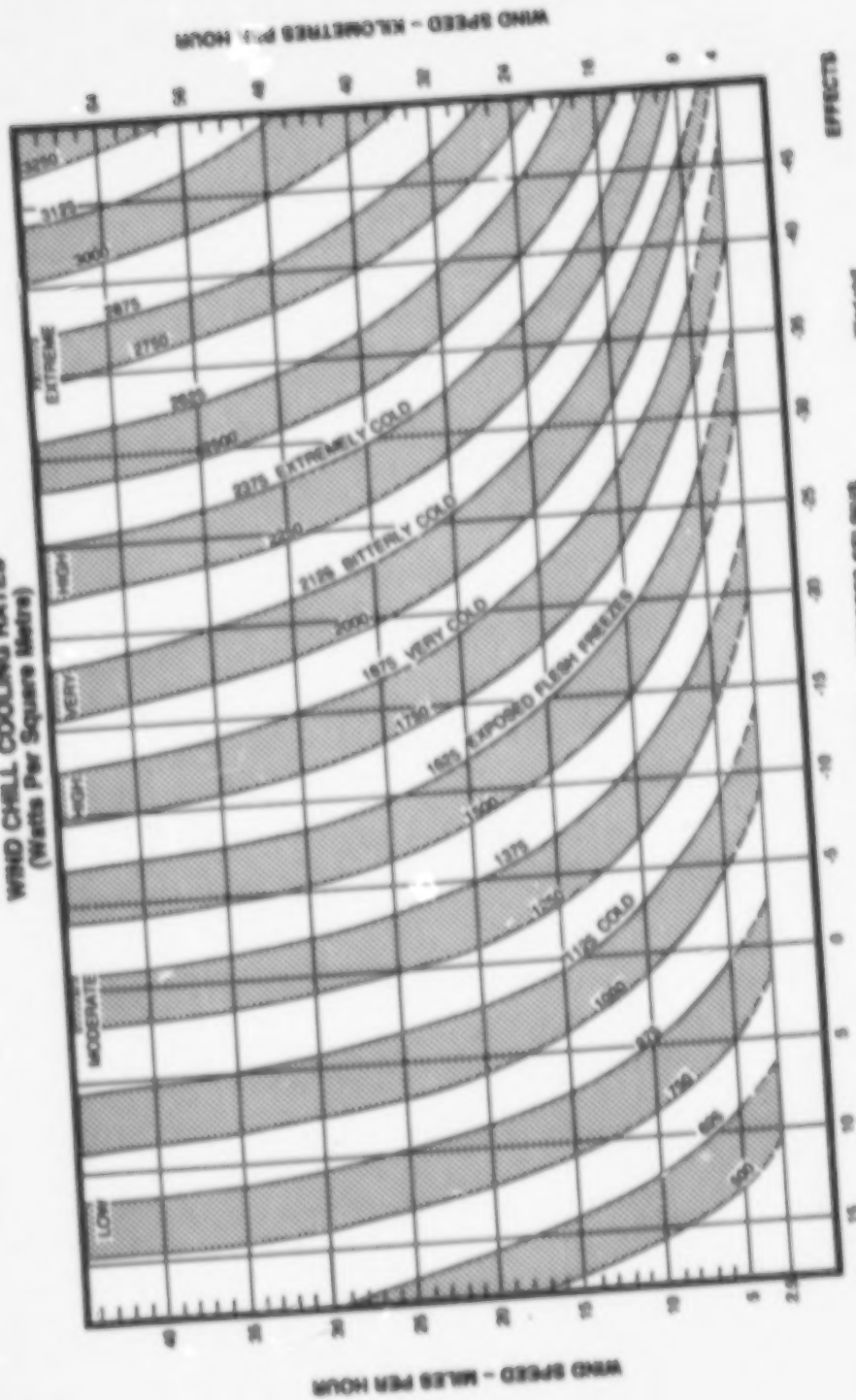
ANNEX IV b



To determine the wind chill factor follow the temperature across and the wind speed up until the two lines intersect. The value of the wind chill factor can be interpolated using the labeled wind chill factor curves.

For example, at -10°C with a wind speed of 20 miles per hour the point of intersection lies between 1600 and 1825, or approximately 1725.

It is not recommended that wind chill factors be calculated for wind speeds below 5 miles an hour, since it is difficult to determine wind chill factors at these wind speeds and because other factors such as relative humidity become important.

WIND CHILL COOLING RATES
(Watts Per Square Metre)

Wind Chill Factor as described in this paragraph is a measure of the combined cooling effect of wind and temperature. Although the actual calculation of the factor is based upon how fast water will cool with the combination of low temperature and wind, it has been found to be equally applicable to the cooling effect experienced by the human body and by an inanimate object.

The advantage of Wind Chill Factor over other measurements methods is that it represents a real rate of cooling, in other words how fast an object cools. For example, the combination of a specific temperature and wind speed can be related to how fast exposed flesh will freeze. On the average the value of 1625 watts per square metre represents the condition where exposed flesh will freeze in one hour. It also gives an indication of how difficult it is to maintain an object at a given temperature.

In the past it has been common practice to use an equivalent temperature (fictitious temperature) to relate wind and temperature. Unfortunately the values obtained by this method often have been beyond the experience of most people. For example, -30°C occurs in relatively unpopulated areas of Canada. More importantly the equivalent temperature will often not relate to the combined effect of wind and temperature on the human body. It also is not easily combined with the actual temperature.

AIR TEMPERATURE - DEGREES CELSIUS
EXAMPLES OF THE EFFECT OF
WIND CHILL FACTOR

1. Water will freeze more quickly at high wind chill factors than at low.
2. The ability of an engine block heater to keep a car engine warm decreases with increasing wind chill factor.
3. The length of time a car can be left turned off before reaching the surrounding air temperature decreases with increasing wind chill factor.
4. With increasing wind chill factor there is an increase in the heat needed to heat buildings, particularly when the building is poorly insulated.
5. Exposed flesh freezes more rapidly with higher wind chill factors.

Wind chill
Factor

Conditions considered comfortable when dressed for skiing.
Conditions no longer pleasant for outdoor activities on overcast days.
Conditions no longer pleasant for outdoor activities on sunny days.
Freezing of exposed skin begins for most people depending on the degree of activity and the amount of sun-protective clothing.
Conditions for outdoor work such as walking become dangerous. Exposed areas of the face freeze in less than 1 minute for the average person.
Exposed flesh will freeze within half a minute for the average person.

The units of Wind Chill Factor used in this paragraph are watts per square metre.

(Courtesy of Department of the Environment Assessment Environment Services)

TABLE 1

WIND CHILL TEMPERATURES

Air Temperatures Reduced to a 5 Mile per Hour Wind Speed																	
WTWD (mph)	32°F	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	
5	32	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	
10	22	20	19	18	17	16	14	13	12	11	10	8	7	6	5	4	
12	19	17	16	15	14	13	11	10	9	8	7	5	4	3	2	0	
14	17	14	13	12	11	10	8	7	6	5	4	2	1	0	-2	-3	
16	15	12	11	10	9	8	6	4	3	2	1	-1	-2	-3	-5	-6	
18	13	10	9	8	7	6	4	2	1	0	-2	-3	-4	-6	-7	-8	
20	11	8	7	6	5	4	2	0	-1	-2	-4	-5	-6	-8	-9	-10	
25	7	5	4	3	1	0	-2	-3	-5	-6	-8	-9	-10	-12	-13	-14	
30	5	3	1	0	-2	-3	-5	-6	-8	-9	-11	-12	-14	-15	-16	-17	
35	3	1	-1	-2	-4	-5	-7	-8	-10	-11	-13	-14	-16	-17	-19	-20	
40	2	-1	-2	-4	-5	-7	-8	-9	-11	-13	-15	-16	-17	-19	-21	-22	
45	1	-2	-3	-5	-6	-8	-9	-10	-12	-14	-16	-17	-18	-20	-22	-23	
50	0	-2	-4	-6	-7	-9	-10	-11	-13	-15	-17	-18	-20	-21	-23	-24	

ANNEX V

INTERNATIONAL CONFERENCE

ON

SAFETY OF LIFE AT SEA
1974

CHAPTER III

LIFE-SAVING APPLIANCES, ETC.

Regulation 22

Life-jackets

(a) Ships shall carry for every person on board a life-jacket of an approved type and, in addition, unless these life-jackets can be adapted for use by children, a sufficient number of life-jackets suitable for children. Each life-jacket shall be suitably marked showing that it has been approved by the Administration.

(b) In addition to the life-jackets required by paragraph (a) of this Regulation there shall be carried on passenger ships life-jackets for 5 per cent of the total number of persons on board. These life-jackets shall be stowed in a conspicuous place on deck.

(c) An approved life-jacket shall comply with the following requirements:

- (i) it shall be constructed with proper workmanship and materials;
- (ii) it shall be so constructed as to eliminate so far as possible all risk of its being put on incorrectly, except that it shall be capable of being worn inside out;
- (iii) it shall be capable of lifting the face of an exhausted or unconscious person out of the water and holding it above the water with the body inclined backwards from its vertical position;
- (iv) it shall be capable of turning the body in the water from any position to a safe floating position with the body inclined backwards from its vertical position;
- (v) it shall not be adversely affected by oil or oil products;
- (vi) it shall be of a highly visible colour;
- (vii) it shall be fitted with an approved whistle, firmly secured by a cord;
- (viii) the buoyancy of the life-jacket required to provide the foregoing performance shall not be reduced by more than 5 per cent after 24 hours' submergence in fresh water.

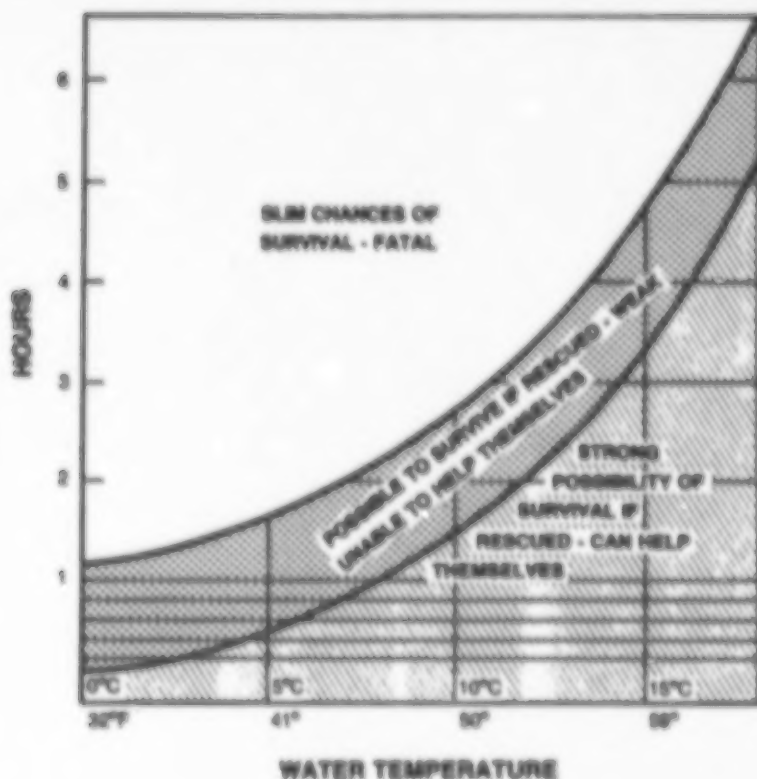
(d) A life-jacket, the buoyancy of which depends on inflation, may be permitted for use by the crews of all ships except passenger ships and tankers provided that:

- (i) it has two separate inflatable compartments;
- (ii) it is capable of being inflated both mechanically and by mouth; and
- (iii) it complies with the requirements of paragraph (c) of this Regulation with either compartment inflated separately.

(e) Life-jackets shall be so placed as to be readily accessible and their position shall be plainly indicated.

ANNEX VI

COLD WATER SURVIVAL

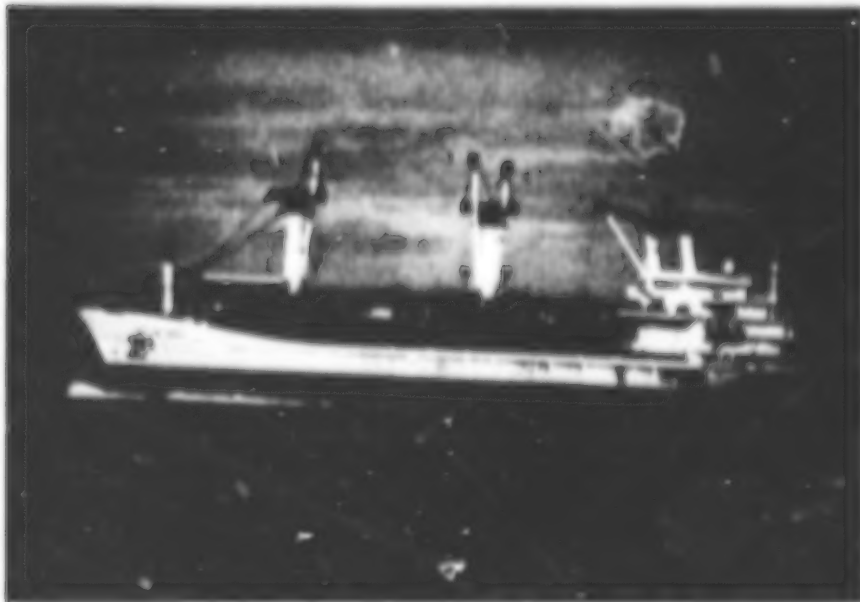


The accompanying graph shows average predicted survival times of average, adult humans in water of different temperatures. The figures are based on experimental cooling of average man and woman who were holding still in ocean water and wearing a standard lifejacket and light clothing. The graph shows, for example, that predicted survival time is about 2½-3 hours in water of 10°C (50°F). Predicted survival time is increased by extra body fat and decreased by small body size. Although women generally possess slightly more fat than men they cool slightly faster due to their usually small body size. However, for comparable sizes, the man will cool faster.

"COLD WATER SURVIVAL"
CANADIAN RED CROSS

Photographs representing cargo stowage by courtesy
of Transcan Marine Consultants, Texas

Photographies représentant l'arrimage de la cargaison
(Courtoisie de Transcan Marine Consultants, Texas).



"CAPITAINE TORRES" Great Lakes, inbound and in ballast,
November 12, 1989.

"CAPITAINE TORRES" montant sur lest, dans les
Grands Lacs le 12 novembre 1989.



"CAPITAINE TORRES" in Lake Huron outbound
November 29, 1989

"CAPITAINE TORRES" descendant le Lac Huron
le 29 novembre 1989.

"CAPITAINE TORRES"



No. 2 tween deck.

Entrepont N°2.



No. 3 lower hold.

Cale N°3.

"CAPITAINE TORRES"



No. 2 hatch cover.

Panneaux d'écouille N°2.



No. 3 hatch cover.

Panneaux d'écouille N°3.